ANDHRA UNIVERSITY
VISAKHAPATNAM

COMMON SCHEME OF INSTRUCTION & EXAMINATION

(With effect from **2006-2007** admitted batch onwards)

I-YEAR

Code No.	Course	Credits	Periods L/T/Lab	Sessional Marks	Exam Marks
ENG 1001	English	2	2+1	30	70
ENG 1002	Mathematics – I	4	3	30	70
ENG 1003	Mathematics – II	4	3	30	70
ENG 1004	Physics Theory	4	3	30	70
ENG 1005	Chemistry Theory	4	3	30	70
ENG 1006	History of Science And Technology	2	3	30	70
ENG 1007	Comp. Prog. And Num. Met4	4	3	30	70
ENG 1008	Engineering Graphics	5	2+4	30	70
ENG 1009	Physics Laboratory	2	3	50	50
ENG 1010	Chemistry Laboratory	2	3	50	50
ENG 1011	Workshop	2	3	50	50
ENG 1012	Programming Laboratory	2	3	50	50
Total		***37***	**39**	**440**	**760**

II YEAR
FIRST SEMESTER

Code	Name of the subject	Periods per week		Max. marks		Credits
		Lec.	Lab/Dwg.	Exam	Sess.	
MEC 211	Mathematics – III	5		70	30	4
MEC 212	Engineering Mechanics	5		70	30	4
MEC 213	Mechanics of Solids – I	5		70	30	4
MEC 214	Engineering Thermodynamics – I	5		70	30	4
MEC 215	Machine Drawing		3	70	30	4
MEC 216	Manufacturing Technology – I	5		70	30	4
MEC 217	Strength of Materials Lab		3	50	50	2
MEC 218	Mechanical Engineering Lab – I		3	50	50	2
Total		25	9	520	280	28

SECOND SEMESTER

MEC 221	Mathematics – IV	5		70	30	4
MEC 222	Material Science	5		70	30	4

MEC 223	Environmental Sciences	5		70	30	2
MEC 224	Electrical Technology	5		70	30	4
MEC 225	Theory of Machines-I	5		70	30	4
MEC 226	Manufacturing Technology – II	5		70	30	4
MEC 227	Manufacturing Technology Lab– I		3	50	50	2
MEC 228	Electrical Engineering Lab		3	50	50	2
Total		30	6	520	280	26

III YEAR
FIRST SEMESTER

Code	Name of the subject	Periods per week		Max. marks		Credits
		Lec.	Lab/Dwg.	Exam	Sess.	
MEC 311	Industrial Electronics	5		70	30	4
MEC 312	Mechanics of Solids – II	5		70	30	4
MEC 313	Engineering Thermodynamics – II	5		70	30	4
MEC 314	Theory of Machines – II	5		70	30	4
MEC 315	Production Drawing		3	70	30	4
MEC 316	Elective-I	5		70	30	4
MEC 317	Mechanical Engineering Lab – II		3	50	50	2
MEC 318	Manufacturing Technology Lab–II		3	50	50	2
MEC 319	Soft Skills Lab		3		100	1
Total		25	12	520	380	29

SECOND SEMESTER

MEC 321	Fluid Mechanics	5		70	30	4
MEC 322	Design of Machine Elements – I	5		70	30	4
MEC 323	Manufacturing Technology – III	5		70	30	4
MEC 324	Industrial Engineering and Management	5		70	30	4
MEC 325	Elective-II	5		70	30	4
MEC 326	Engineering Thermodynamics-III	5		70	30	4
MEC 327	Metrology Lab/Mechatronics Lab		3	50	50	2
MCH 328	Industrial Engineering Lab		3	50	50	2
	Industrial Training *					
Total		30	6	520	280	28

*During summer vacation

IV YEAR
FIRST SEMESTER

Code	Name of the subject	Periods per week		Max. marks		Credits
		Lec.	Lab/Dwg.	Exam	Sess.	
MEC 411	Design of Machine Elements-II	5		70	30	4
MEC 412	Heat and Mass Transfer	5		70	30	4
MEC 413	Fluid Machinery and Systems	5		70	30	4
MEC 414	Statistical Quality Control	5		70	30	4
MEC 415	Elective – III	5		70	30	4
MEC 416	Operation Research	5		70	30	4
MEC 417	Heat and Mass Transfer Lab		3	50	50	2
MME 418	FMM Lab		3	50	50	2
MME419	Industrial Training				100	2
Total		30	6	520	380	30

SECOND SEMESTER

MEC 421	Instrumentation and Control Systems	5		70	30	4
MEC 422	Computer Aided Design	5		70	30	4

MEC 423	Engineering Economics	5		70	30	4
MEC 424	Project		6	50	50	8
MEC 425	Computer Aided Design Lab		3	50	50	2
Total		15	9	310	190	22

Elective – I : (A) Refrigeration and Air Conditioning
(B) Advanced Foundry and Welding Technology
(C) Work Study
(D) Power Plant Engineering
(E) Finite Element Analysis
(F) Computer Graphics

Elective – II : (A) Gas Turbines and Jet Propulsion
(B) Automobile Engineering
(C) Tool Design
(D) Production Planning and Control
(E) Robotics
(F) Mechatronics

Elective – III : (A) Computational Fluid Dynamics
(B) Non Conventional Energy Sources
(C) Computer Numerical Control and Computer Aided Manufacturing
(D) Total Quality Management
(E) Optimization Design
(F) Engineering Tribology

ENG 1001 English

The emphasis on English Language is enormously increasing as an effective medium of communication in all sectors the World over. As a consequence of this, the acquisition of effective communication skills in English has become most important to the students to flourish in their careers. In this connection there is a need to train the students to equip themselves with the necessary skills required for effective communication in English thereby enabling them to get a good placement immediately after the completion of their undergraduate courses. To meet the objectives of developing proficiency in English communication skills and developing Listening, Speaking, Reading and Writing (LSRW) skills. The following curriculum is designed for favorable consideration.

Course Objectives:

- To improve the language proficiency of the students in English with emphasis on Reading and Writing skills.
- To enable the students to study engineering subjects with greater comprehension & cognizance.
- To strengthen the vocabulary of the students
- To enable the students to write grammatically correct structures with logical flow.
- To equip the students with the knowledge of different formats of business communication.

Course Outcomes

At the end of the course the student will be able to:

CO-1	Write and construct grammatically correct sentences.
CO-2	Analyze the structure of the phrases, clauses and sentences.
CO-3	Apply his enriched vocabulary to give better shape to his communication skills.
CO-4	Effectively use different formats of business correspondence.
CO-5	Use idiomatic expressions and foreign phrases in his communication.

. Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								1	1	3		
CO2												
CO3									1	3		
CO4								1	1	3	1	
CO5									1	3	1	

Curriculum : Theory And Practice (Language Lab)

1. **A Text With Focus On Skills Approach**
   Intended to develop the language skills of Listening. Speaking, Reading and Writing.

2. **Vocabulary :**

a) One – Word Substitutes.
b) Words often Confused – Pairs of Words.
c) Synonyms and Antonyms.
d) Foreign Phrases.
e) Phrasal verbs derived from the following dynamic verbs_Go, Get, Run, Take, Look, Hold, Put, Stand Etc.
f) Idioms and phrases.

3. Grammar :

a) Error Analysis

- Correction of Errors in a given sentence – errors in the use of words – errors of indianisms – use of slang – errors in punctuation

b) Concord
c) Articles, Prepositions and words followed by prepositions.
d) Tenses.

4. Writing skills :

1. Précis writing
2. Note Making
3. Letter writing.
4. Technical Report Writing.
5. Preparation of C.V and Resume writing.
6. Reading Comprehension.
7. Memo.
8. Notices/Circulars Agenda and Minutes of a Meeting.
9. E-Mail etiquette
10. Essay writing.

Text Book Prescribed :

In order to improve the proficiency of the student in the acquisition of the above mention skills, the following texts and course content is prescribed.

- **Learning English:** A Communicative Approach, Hyderabad: Orient Long man. (selected lessons)

The following lessons are prescribed from the above Text:

i) Astronomy (1)
ii) Travel and Transport (3)
iii) Humour (4)
iv) Environment (6)
v) Inspiration (7)
vi) Human Interest (8)

Reference Books Prescribed :

1. Sharma, G.V.L.N., **English for Engineering Students**.
2. Margaret M Maison, **Examine your English**, Orient Longman
3. Krishnaswami,N and Sriraman, T., **Current English for Colleges**, Macmillan.
4. Krishnaswami, N. and Sriraman, T., **Creative English for Communication**, Macmillan.
5. Rizvi, M Ashraf. **Effective Technical Communication.** McGraw – Hill.
6. English for Technical Communication K.R Lakshminarayana, SCITECH.

ENG 1002 MATHEMATICS-I

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objective:

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering

Course Outcomes:

Students will be able to:

CO-1	Understand functions of several variables.
CO-2	Understand the basic concepts of convergence and divergence of series
CO-3	Apply Fourier series to engineering problems
CO-4	Understand the concept of three dimensional analytical geometry
CO-5	Solve engineering problems related to multiple integrals

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1							1	
CO2												
CO3	2	1		1	1						1	
CO4	3	1		1					1		1	1
CO5	3	1		1	1				1		1	1

Partial Differentiation and its applications:
Functions of Two or More Variables, Partial Derivatives, Homogeneous Functions- Euler's Theorem, Total Derivative. Differentiation of Implicit Functions, Geometrical Interpretation- Tangent Plane and Normal to a surface. Change of Variables, Jacobians, Taylor's Theorem for functions of two variables. Jacobians, Taylor's Theorem for functions of two variables. Errors and approximations. Total Differential, Maxima and Minima of functions two variables. Lagrange's method of undetermined multiples, Differentiation under the integral sign – Leibnitz Rule. Involutes and evolutes.

Multiple integrals and their applications:
Double integrals. Change of order of integration. Double integrals in Polar Co-ordinates, Areas enclosed by plane curves. Triple integrals. Volume of solids. Change of variables. Area of a curve of a curved surface. Calculation of Mass, Center of gravity, Center of pressure, Moment of inertia. Product of inertia. Principle Axes. Beta function, Gamma function. Relation between Beta and Gamma functions. Error function or Probability integral.

Solid geometry (Vector Treatment):

Equation of a plane. Equations of Straight line. Condition for a line to lie in a plane. Coplanar lines. Shortest distance between two lines. Interaction of three planes. Equation of Sphere, Tangent plane to a sphere. Cone, cylinder, Quadric surfaces.

Infinite series:
Definitions. Convergence, Divergence and oscillation of a series, General properties, series of Positive terms, comparison tests, Integral test. D'Alembert's ratio test. Raabe's test. Logarithmic test. Cauchy's Root test. Alternating series- Leibnitz's rule, Series of positive or negative terms. Power series. Convergence of exponential. Logerithmic and Bionomial series. Uniform convergence. Weirstrass M-test. Properties of uniformly convergent series.

Fourier series:
Euler's formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even functions – Expansions of odd or even periodic function. Half range series. Parsevel formula, Practical Harmonic analysis.

Text Books:
1. Higher Engineering Mathematics by B.S.Grewal
2. Mathematics for Engineering by Chandrica Prasad.

Reference Books:
1. Higher Engineering Mathematics by M.K.Venkatraman.
2. Advanced Engineering Mathematics by Erwin Kreyszig.

ENG 1003 MATHEMATICS-II

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objective:

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

Course Outcomes:

The student will be able to:

CO-1	Apply advanced matrix knowledge to Engineering problems
CO-2	Apply differential equations to Engineering problems.
CO-3	Apply Laplace transform to Engineering problems.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1						1	1
CO2	1	1	1	1	1						1	1
CO3	1	1	1	1	1						1	1

Linear Algebra:
Rank of a Matrix. Eigen values Eigen vectors of a Matrix. Cayley Hamilton Theorem. Consistency of equations. Matrix Invertion, Gaussian Elimination Scheme. Cholesky factorization. Jacobi and Gauss-Seidal Iterative Methods for solving simultaneous equations. Eigen Value solution using forward iteration. Inverse itrration. Hermitian and skew Hermitian forms. Unitary Matrix, Functions of a Matrix. Quadratic forms and Conical forms.

Differential Equations Of First Order And Its Applications:
Formation of differential equation. Solution of a differential equation. Geometrical meaning. Equations the first order and first degree. Variables separable, Homogeneous equations. Linear equations. Bernoulli's equation. Exact equations. Equation reducible to exact equations. Equations of the first order and higher degree. Calirut's equation. Geometric applications. Orthogonal trajectories, Physical applications. Simple Electric circuits. Heat flow, Chemical applications. Newton's law of cooling.

Linear Differential Equations:
Higher order linear differential equations with constant Coefficients. Deflection of beams. Simple harmonic motion. Oscillatory Electric circuits.

Series solutions of differential equations:

Frobenis method, Special function as solution from series. Bessel equation, Bessel functions of first and second kind. Equation reducible to Bessel's equations. Legender's equations, Legender Polynomial, Rodrigues formula, Generating functions. Recurrence relation. Orthonogolity relation for Bessel functions and Legendre Polynomial.

Laplace transforms:
Transforms of elementary functions. Properties of Laplace Transforms, Existence conditions, Inverse transforms, Transform of derivatives, Transform of Integrals. Multiplication's by 't'-division by 't'. Convolution theorem. Application to ordinary differential equations and simultaneous linear equations with constant coefficients. Unit step function, Impulse functions and periodic functions.

Text Books:
1. Theory of Matrices by Shantinarayanan.
2. Higher Engineering Mathematics by B.S. Grewal
3. Adv. Math for Engg students, vol. 2 by Narayana, Manieavachgon Pillay, Ramanaiah

Reference Books:
1. Higher Engineering Mathematics by M.K.Venkataraman.
2. Advanced Engineering Mathematics by Erwin Kreyozig.
3. Engineering Mathematics by P.P. Gupta.
4. A text book on Engg Mathematics by N.P.Bali.

ENG. 1004 PHYSICS

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objectives:

- To impart knowledge in basic concepts of physics relevant to engineering applications
- To introduce advances in technology for engineering applications

Course Outcomes:

The students will be:

CO-1	Able to design and conduct simple experiments as well as analyse and interpret data in engineering applications
CO-2	Capable of understanding advanced topics in engineering
CO-3	Able to identify formula and solve engineering problems
CO-4	Able to apply quantum physics to electrical phenomena

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3			1		1	1	1	1
CO2	3	3	3	2			1		1	1	1	1
CO3	3	3	2	2			1		1	1	1	1
CO4									1	1		1

Thermodynamics
Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Entropy, Second law of thermodynamics, Entropy and disorder, Entropy and Probability, Third law of thermodynamics. Thermography and its Applications.

Electromagnetism
Concept of electric field – Point charge in electric field, dipole in an electric field. Gauss law, some applications, electric potential and field strength, potential due to a point charge and dipole.

Magnetic field – magnetic force on current, torque on current loop, Hall effect, Ampere's law, B near a long wire, B for a solenoid and Toroid. The Biot-Savart,s Law. B for a circular Current loop.

Faraday's law of induction. Lenz's law, Calculation of Inductance. L-R Circuit. Energy stored in Magnetic field. Induced magnetic fields, Displacement current. Energy density in Electric and Magnetic fields, Poynting Vector S.

Maxwells equations and Electromagnetic waves (Both differential and Integral forms). Magnetic properties of materials. Paramagnetism, Diamagnetism, Ferromagnetism, Ferrites

and its applications.

OPTICS

Interference – Principles of superposition – Young's Experiment – Coherence – Interference of thin films, Wedge shaped film, Newtons Rings, Michelson Interferometer and its applications.

Diffraction – Single slit (Qualitative and quantitative treatment).

Polarisation – Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization and detection.

LASERS AND FIBRE OPTICS

Spontaneous and stimulated emissions, population inversions, Ruby laser, Gas laser, Semiconductor laser, Applications of lasers.

Fibre Optics, Optical Fibre and Total Internal Reflection, Acceptance Angle and cone of a fibre, Fibre optics in communications, Optical parts in Fibre. Fibre Optic Sensors.

ULTRASONICS

Production of Ultrasonics by Magnetostriction and Piezoelectric effects – Ultrasonics and diffraction pattern, Applications of Ultrasonics.

MODERN PHYSICS

The quantization of energy, Photoelectric effect, De Broglie concept of matter waves, uncertainty principle, Schrodinger wave equation, application to a particle in a box.

Elementary concepts of Maxwell-Boltzman, Bose-Einstein's and Fermi Dirac Statistics. Fermi Dirac Distribution function (no derivations).

Free electron theory of metals, Band theory of solids, Kronig Penny Model, Metals, Insulators and Semiconductors. Ferroelectrics and their applications

Super conductivity, Meisner Effect, Types of Superconductors and Applications of Superconductors.

Nanophase materials – Synthesis, characterization of nanostructured materials, properties and applications.

Renewable energies – Solar, wind and tidal – Applications

Books Recommended

1. Engineering Physics by R.K. Gaur and S.D. Gupta
2. Physics by David Halliday and Robert Resnick – Part I and Part II
3. Modern Engineering Physics by A.S. Vadudeva
4. University Physics by Young and Freedman
5. Materials Science by V. Rajendra and A. Marikani
6. Nonconventional Energy by Ashoke V. Desai

ENG 1005 CHEMISTRY

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objectives:

This Course aims the students

- To provide knowledge on problems associated with impure water and various technologies available in water treatment.
- To know the importance of materials, properties and their applications in various fields of Engineering.
- To provide basic knowledge on Energy resources such as Fossil Fuels and importance of chemical energy and developments in batteries and fuel cells.
- To understand different ways of corrosion of metals, various options to prevent corrosion and suitable methods for the control of corrosion.
- To create awareness on advance concepts like nanomaterials , LCDS, OLEDs, etc
- To guide students in understanding the principles of green chemistry and importance of eco-friendly technologies for future development.
- To enable the student to carry out their future projects in interdisciplinary areas.

Course Outcomes:

The student will be:

CO-1	Able to adopt the suitable technology for wastewater treatment
CO-2	Able to design suitable batteries for different applications.
CO-3	Ability to identify & Generalize the properties of Materials used in various engineering fields.
CO-4	Able to select and design of suitable material to prevent corrosion and protecting metals from corrosion.
CO-5	Able to develop green technologies for industrial processes.
CO-6	Able to solve scientific problems related to various engineering works.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2			1	1					
CO2			2	1			2				1	
CO3	1	1	1	1			2				1	
CO4	1	1	1	1			1				1	
CO5	1	2	2	2		1	3			1	1	1
CO6	1	1	1	1	1		1			1	1	1

1. **Water Chemistry and pollution:**

   Water Chemistry: Sources of water - impurities – Hardness and its determination – W.H.O. limits. Boiler troubles and their removal. Water softening methods – Lime Soda, Zeolite and Ion exchange. Municipal water treatment – Break point chlorination. Desalination of Sea Water - Electrodialysis and Reverse osmosis methods.
   Water pollution: Source – BOD – COD – Sewage treatment - preliminary, primary, secondary and tertiary.
   Air Pollution: Source – Air pollutants – CO , SOx , NOx , Hydrocarbons and particulates. Acid rain – Green House effect – control of Air pollution (General).

2. **Solid State Chemistry:**
   Classification of Solids – Types of Crystals – Properties - imperfections in crystals. Band theory of solids. Chemistry of Semiconductors - Intrinsic, extrinsic, compound and defect. Organic semiconductors and superconductivity. Purification of solids by zone refining - Single crystal growth – epitaxial growth. Elementary ideas on liquid crystals.

3. **Energy Sources:**
   Thermal Energy: Coal- Ranking of coal - analysis (proximate and ultimate) Calorific value and determination (Bomb calorimeter method) – COKE – Manufacture – Otto Hoffmann's process – Applications.
   Chemical Energy: Electrode potential – Calomel electrode – Galvanic cells – primary secondary – Acid and alkaline cells – fuel cells.
   Nuclear Energy : Fission and fusion – power rectors – Atomic pile applications .
   Solar Energy : Methods of utilization – thermal conversion – Liquid Flat – Plate collector – Photovoltaic conversion - solar cell - Applications.

4. **Corrosion Chemistry :**
   Origin and theories of corrosion – Types of corrosion - Factors affecting corrosion – corrosion control methods . Protective coatings –Metallic coatings – Chemical conversion coatings - phosphate , chromate , Anodized . Organic Coating – paints – special paints – Varnishes and lacquers.

5. **Fuels and Lubricants:**
   Petroleum – refining - Motor fuels – Petrol and Diesel Oil - Knocking – Octane number - Cetane number. Synthetic petrol – Fisher - Tropsch and Bergius methods. LPG and CNG - Applications. Rocket fuels -Propellants - Classification.
   Lubricants: Classification - mechanism - properties of lubricating oils - Selection of lubricants for Engineering applications.

6. **Polymers and Plastics:**
   Definition – Types of polymerization – Mechanism of addition polymerization. Effect of polymer sructure on properties. Plastics – Thermoplastic resins and Thermosetting resins - Compounding of plastics – Fabrication of plastics. Preparation and properties of cellulose derivatives - Vinyl resins-Nylon(6,6)- bakelites – polycarbonates - epoxy resins. Reinforced plastics. Conducting polymers. Engineering applications of polymers.

7. **Building Materials:**
   Portland Cement: Manufacture - Dry and Wet process. Setting and hardening of cement - Cement concrete - RCC - Decay of concrete - special cements.

Refractories: Classifications - properties - Engineering applications.
Ceramics: Classification - Properties - uses.

Prescribed Text Books

1. Engineering Chemistry, P.C. Jain and M. Jain - Dhanapathi Rai & Sons, Delhi
2. A text book of Engineering Chemistry, S.S. Dara - S. Chand & Co. New Delhi
3. Engineering Chemistry, B.K. Sharma - Krishna Prakashan, Meerut
4. A text book of Engineering Chemistry, - Allied Publishers Balasubramanian et.al.,
5. Material Science and Engineering V. Raghavan - Prentice-Hall India Ltd.,

ENG 1006 HISTORY OF SCIENCE AND TECHNOLOGY

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objective:

To make the students to understand how the science and technology developed in India.

Course Outcomes:

The students will be able to understand

CO-1	The consequences and requirements for the development of science and technology in Indian Scenario.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2			1	1	2				

1. **Historical Perspective :**
   The Nature of Science and Technology , Roots of Science and Technology in India , Science and Society , Scientists and Society , Science and Faith and The Rise of Applied Sciences.

2. **Polices and Plans After Independence :**
   Nehru's vision of Science for Independent India, Science and Technology Developments in the New Era Science and Technology Developments during the Five Year Plan Periods and Science and Technology Policy Resolutions.

3. **Research and Development (R&D) in India :**
   Expenditure in R&D, Science and Technology Education, Research Activities and Promotion of Technology Development, Technology Mission, Programms Aimed at Technological self Reliance, Activities of Council of Scientific and Industrial Research (CSIR).

4. **Science and Technological Developments in Major Areas :**
   Space – Objectives of Space Programms, Geostationary Satellite Services – INSAT System and INSAT Services Remote Sensing Applications, Launch Vehicle Technology
   Ocean Development – Objectives of Ocean Development, Biological and Mineral Resources, Marine Research and Capacity Building;
   Defense Research --- Spin –off Technologies for Civilian Use;
   Biotechnology--Applications of Biotechnology in – Medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of Biosensors and Animal Husbandry;
   Energy – Research and Development in Conservation of Energy , India's Nuclear Energy Programme –Technology Spin –offs.

5. **Nexus Between Technology Transfer and Development :**

Transfer of Technology—Types, Methods, Mechanisms, Process, Channels and Techniques: Appropriate Technology, Technology Assessment, Technological Forecasting, Technological Innovations and Barriers of Technological Change.

Test Books :

1. Kalpana Rajaram , **Science and Technology in India,** Published and Distributed by Spectrum Books (P) Ltd., New Delhi-58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East – West Press (P) Ltd., New Delhi.

Reference Books :

1. Ramasamy , K. A. and Seshagiri Rao, K.,(Eds**.) Science, Technology and Education for Development,** K., Nayudamma Memorial Science Foundation, Channai-8.
2. Kohili, G. R., **The Role and impact of Science and Technology in The development of India,** Surjeet Publications.
3. Government of India, **Five Year Plans**, Planning Commission, New Delhi. Sharma, K. D. and Quresh M. A., **Science, Technology and Development**, Sterling Publications (p) Ltd. New Delhi.

ENG 1007 COMPUTER PROGRAMMING AND NUMERICAL METHODS

Lectures/week = 3 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objectives:

- To enable students to gain elementary knowledge of different parts of computer, operating system, etc.
- To familiarize the student with basic concepts of computer programming and developer tools.
- To enable students to have basic understanding and step-by-step developing the solution to solving the problems.
- To enable students understand the approaches of different programming languages and fundamentals of C language.
- To present the syntax and semantics of the "C" language as well as data types offered by the language
- To make students understand the basic control structures of C language.
- To make students understand the concepts of derived data types like arrays, structures and unions, etc.
- To make understand the modular approach/ procedural approach using functions.
- To expose the students to access the data in secondary storage devices using file primitives available in C languages.

Course Outcomes:

The student will be able to:

CO-1	Construct flowcharts and algorithms for solving problems.
CO-2	Design and implement the modules using functions.
CO-3	Use different data structures and create/update basic data files.
CO-4	Write, debug, and document well-structured C programs.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	3							
CO2	1	1	1	1	2							
CO3					1							
CO4	1	1	1	2	2	1						
CO5	1	1	1	1	2							

Section A

Computer Programming in C

Basics: Variables – Constants – Expressions – Operators and their precedence and associativity. Basic input and output statements. Control structures. Simple programs in C using all the operators and control structure.

Functions: Concept of a function – Parameters and how they are passed – Automatic Variables – Recursion – Scope and extent of variables. Writing programs using recursive and non-recursive functions.

Arrays and Strings: Single and multidimensional arrays-Character array as a string- Functions on strings. Writing C Programmes using arrays and for string manipulation.

Structures: Declaring and using structures-Operations on structures – Arrays of structures-User defined data types-Pointers to using files.

Files: Introduction –file structure- File handing functions- file types- Files- Error handing- C Programming examples for using files.

Section B

Computer Oriented Numerical Methods

1. Basic Concepts: Preliminary Concepts of Algorithms-Flow Charts and their execution traces- A Simplified Model of a Computer.
2. Representation for Characters and Numbers: Representation for integer and real numbers. Effect of finite representation on arthimatic operations for example overflow, underflow, associativity and normalization. Some elementary methods for overcoming these limitations.
3. Numerical Methods: Notation of round-off and truncation errors, numerical methods of finding roots of an algebraic equation of one variable. Successive bisection method, False position method, Newton Raphson method and Secant method.
4. Solutions of simultaneous Algebraic Equations; Gauss elimination method and Gauss Seidal methods.
5. Interpolation: Lagrange's Interpolation and difference table methods.
6. Numerical integration: Simpson's rule, Gaussian Quadrature Formula.
7. Numerical Solution of Differential Equation: Euler's method, Taylor's seriesmethod and Runge-Kutta method.

Books:

1. Section A: Programming with C by K.R.Venugopal& Sudeep R Prasad
2. Section B: Introduction to Numerical Methods by S.S Sastry
3. Elementary Numerical Methods by S.D.Conte

Reference:

1. C Programming Language by Kerningham & Ritchie

ENG 1008 ENGINEERING GRAPHICS

Lectures/week = 2+4 Sessional Marks =30
Exam=3 Hrs, Exam. Marks = 70

Course Objectives:

- Increase ability to communicate with people and learn to sketch and take field dimensions.
- To make the student familiar to the drawing practices and convection
- To familiarize the student about various engineering curves used in industry
- To enable the student draft simple engineering components and analyze different views of components.

Course Outcomes:

CO-1	Student's ability to perform basic sketching techniques will improve.
CO-2	Student's will be able to draw orthographic projections and sections
CO-3	Student's ability to use architectural and engineering scales will increase.
CO-4	Student's ability to produce engineering drawing will improve.
CO-5	Student's ability to convert sketches to engineered drawing will increase.
CO-6	Student's will develop good communication skills and team work.

Mapping of Course Out comes with Programme Outcomes.
High-3, Medium-2, Low-1

Course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1
CO1		2	2							2		2
CO2	3	3		2						2		
CO3	3	2							1	3		2
CO4												
CO5												
CO6						1				3		
CO7		2		1	3						2	2

Introduction:
Drawing Instruments and uses. Lettering scales in common use.

Curves:
Curves used in Engineering Practice, conic sections, construction of conics by different methods, rectangular-hyperbola, cycloidal curves, trochoids, epi and hypo-cycloids. involutes and Archemedian spiral.

Orthographic Projections:
Projection of points, projection of straight lines, traces of a line, projection of planes and projection on auxiliary planes.

Solids and Developments:
Projection of solids in simple positions, projection of solids with axis inclined to one of the reference planes and parallel to the other, projection of solids with axis inclined to both the reference planes. Projection of spheres. Development of surfaces of solids. Development of transition piece connecting a square and circular pipe. Helices and screw threads.

Sections and Intersections:
Sections of different solids and true shape of sections. Intersection of surfaces-simple problems with cylinders, prisms and cones.

Isometric and Perspective Projections:
Isometric projection and conversion of orthographic projection into isometric projection. Perspective projection. Theory of visual ray method and vanishing point method. Simple problems involving regular geometrical solids.

Textbook:
1. Elements of Engineering Drawing by N.D. Bhatt

Reference:
1. Engineering Graphics by K.L. Narayana and P. Kannaiah

ENG 1009 PHYSICS LABORATORY

Practicals/week = 3 Sessional Marks =50
Exam=3 Hrs, Exam. Marks = 50

Course objective:

To enable the students to acquire skill, technique and utilization of the instruments.

Course outcomes:

Students will be able to:

CO-1	Design and conduct experiments as well as to analyze and interpret data
CO-2	Identify, solve and apply fundamental physics principles to solve engineering problems.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2		2		2	2	2	1	1
CO2	3	2	1	2		2		2	2	2	1	1

12 of the following experiments must be completed:

1. Lee's method- determination of coefficient of thermal conductivity of a bad conductor
2. Melde's experiment-determination of the frequency of an electrically maintained tuning fork.
3. Newton's rings – determination of radius of curvature of a convex lens.
4. Diffraction grating-determination of wavelengths in mercury line spectrum-using spectrometer
5. Determination of Cauchy's constants using Spectrometer and mercury light.
6. Wedge method-det. of thickness of a paper by forming parallel interference fringes.
7. Michelson's interferometer- a) det. of wavelength of light b) Resolution of spectral lines.
8. Det. of □□ using calcite crystal.
9. Optical Bench – a) Young's double slit b) Lloyd's mirror c) biprism d) diffraction at an edge e) Thickness of wire
10. Ultrasonic Diffraction – Velocity of ultrasonic waves in liquids.
11. Variation of magnetic field along the axis of current carrying circular coil – Stewart and Gee's apparatus
12. Calibration of voltmeter using potentiometer
13. Carey Foster's bridge a) laws of resistance b) temperature coefficient of resistance
14. B-H curves – determination of hysterisis loss

15. Calendar and Barnes method – determination of specific heat of water
16. Hall effect – a) Determination of hall coefficient B) determination of charge density
17. Photoelectric effect – a) characteristics of photoelectric cell b) det. of Planck's const.
18. Determination of Rydberg constant using hydrogen discharge tube
19. Determination of e/m of am electron – Thomson's method
20. Determination of band gap of semi conductor.

ENG 1010 CHEMISTRY LABORATORY

Practicals/week = 3 Sessional Marks =50
Exam=3 Hrs, Exam. Marks = 50

Course Objectives:

- To attain clear idea over quantitative chemical analysis.
- To improve skills in analyzing samples through titration procedures.
- To get an idea over Instrumental methods of analysis for more accuracy.
- To know about methods of analyzing the ore samples.

Course Outcomes:

The students will be:

CO- 1	Able to identify the suitable method for analyzing samples.
CO-2	Able to analyze different types of water samples to test quality parameters.
CO-3	Able to use different types of instruments in estimating the composition of materials in

Mapping of course outcomes with program outcomes

High-3, Medium-2, Low-1

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1		1	2					
CO2				1		1	2					
CO3				1		1	2					

List of Experiments:

01. Determination of Sodium Carbonate.
02. Determination of Sulfuric acid using a strong base.
03. Estimation of Iron (II) using Potassium Permanganate.
04. Estimation of Oxalic Acid using Potassium Permanganate.
05. Determination of volume strength of Hydrogen Peroxide.
06. Estimation of Calcium in a sample of Portland cement.
07. Estimation of Chromium (VI) using Ferrous Ammonium Sulphate.
08. Estimation of Copper (II) using Sodium thiosulphate.
09. Analysis of Bleaching powder for Chlorine content.
10. Estimation of Zinc by EDTA method.
11. Determination of hardness of a water sample (EDTA Method).
12. Determination of alkalinity of a water sample.

Demonstration Experiments:

13. Determination of Viscosity of a Lubricating oil.
14. Preparation of Copper pigment.
15. Preparation of Phenol-Formaldehyde resin.
16. Digital pH meter.
17. Digital potentiometer.
18. D.O. Analyser.

ENG 1011 WORKSHOP

Practicals/week = 3 Sessional Marks =50
Exam=3 Hrs, Exam. Marks = 50

Course Objective:

To provide training and hands on experience to the students on basic Engineering related skills like carpentry, fitting, house wiring and tin smithy.

Course Outcomes:

The students will be able to:

CO-1	Make simple carpentry and fitting works
CO-2	Understand and do different types of wiring for practical requirements
CO-3	Develop cross-sections of models for tin smithy and make them.
CO-4	It also helps in understanding of relevant skills required by the engineer

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1							2			1		
CO-2	1						2			1		
CO-3							2			1		
CO-4		2	2						3			

1. **Carpentry:**
   Bench work, tools used in carpentry.
   Jobs for class work – half lap joint, mortise and tenon joint, half –lap dovetail joint, corner dovetail joint, bridle joint.

2. **Sheet Metal:**
   Tools used in sheet metal work. Laying developments of sheet metal jobs, soldering.
   Jobs for class work – square tray, taper side tray, funnel, elbow pipe.

3. **Fitting:**
   Tools used in fitting work. Different files, chisels, hammers and bench vice.
   Jobs for class work – hexagon, rectangular, circular and triangular fits. External and internal threads with dies and taps.

Reference

1. Elements of Workshop technology, Vol.1 by S.K. and H.K. Hajra Choudary

ENG 1012 PROGRAMMING LABORATORY

Practicals/week = 3 Sessional Marks =50
Exam=3 Hrs, Exam. Marks = 50

Course Objectives:

- Understand the program development steps using compilers.
- To strengthen the problem solving skills using programming techniques.
- To design programs using various control structures.
- To be able develop programs using structures, unions and files.

Course Outcomes:

At the end of the course student should be able to:

CO-1	Gain a working knowledge on programming techniques
CO-2	Test C language primitives such as language-defined data types (int, float, char, double), control constructs (sequence, selection, repetition), program modules (including functions, modules, methods)).
CO-3	Exhibit the ability to formulate a program that correctly implements the algorithm.
CO-4	Write, debug, and document well-structured C programs.
CO-5	Develop alternative algorithms for programming problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1							
CO2	1											
CO3	2	2		2	1			1				
CO4	2	1		1	1			1				
CO5	1	1		1	2					1	1	1

1. Write a program to read x,y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while)
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int., long, float and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, Write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given a table of x and corresponding f(x) values, write a program which will determine f(x) value at an intermediate x value using Lagrange's interpolation.
12. Write a function which will invert a matrix.
13. Implement Simpson's rule for numerical integration.
14. Implement Gaussian quadrature for numerical integration.
15. Write a program to solve a set of linear algebraic equations.

B.E. (MECH.) - II/IV
(I-SEMESTER)
MEC 211 - MATHEMATICS-III

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

(Common for ALL branches except Chemical Engineering)

Course Objective:

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering

Course Outcomes:

Students will be able to

CO-1	Formulate and solve partial differential equations.
CO-2	Solve problems in Vector calculus.
CO-3	Apply Fourier transform to boundary value problems and heat conduction problems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1	1	1	1	1						1	1
CO-2	1	1	1	1	1						1	1
CO-3	1	1	1	1	1						1	1

Vector Calculus: Differentiation of vectors; Curves in space; Velocity and acceleration; Relative velocity and acceleration; Scalar and vector point functions; Vector operator ∇. ∇ applied to scalar point functions; Gradient; ∇ applied to vector point functions; Divergence and Curl. Physical interpretations of $\nabla.F$ and $\nabla \times F$ applied twice to point functions; ∇ applied to products of point functions; Integration of vectors; Line integral; Circulation; Work; Surface integral-Flux; Green's theorem in the plane; Stake's theorem; Volume integral; Divergence theorem; Irrotational and Solenoidal fields; Green's theorem; Introduction to orthogonal curvilinear coordinates: Cylindrical; Spherical and polar coordinates.

Introduction to Partial Differential Equations: Formation of partial differential equations; Solutions of a PDEs; Equations solvable by direct integration; Linear equations of first order; Homogeneous linear equations with constant coefficients; Rules for finding the complementary function; Rules for finding the particular integral; Working procedure to solve homogeneous linear equations of any order; Non-homogeneous linear equations.

Applications of Partial Differential Equations: Method of separation of variables; Vibrations of a stretched string-wave equations; One-dimensional heat flow; Two dimensional and two dimensional heat flow equations; Solution of Laplace's equation; Laplace's equation in polar coordinates.

Integral Transforms: Introduction; Definition; Fourier integrals; Sine and cosine integrals; Complex forms of Fourier integral; Fourier transform; Fourier sine and cosine transforms; Finite Fourier sine and cosine transforms; Properties of F-transforms; Convolution theorem for F-transforms; Parseval's identity for F-transforms; Fourier transforms of the derivatives of a function; Application to boundary value problems using inverse Fourier Transforms only.

Text Book:

1. Higher Engineering Mathematics, (34th edition 1998) by B.S. Grewal.

References:

1. A Text Book on Engineering Mathematics, by M.P. Bali et al.
2. Higher Engineering Mathematics by M.K. Venkataraman.
3. Advanced Mathematics for Engineering Students, Vol. 2 & Vol. 3 by Narayanan et al.
4. Advanced Engineering Mathematics by Erwin Kreyszig.
5. Engineering Mathematics by P.P.Gupta.
6. Advanced Engineering Mathematics by V.P.Jaggi and A.B.Mathur.
7. Engineering Mathematics by S.S. Sastry.
8. Advanced Engineering Mathematics by M.L. Das.

MEC 212 - ENGINEERING MECHANICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objective:

To make the students to understand the principles of the effect of forces both kinematics and kinetics, on non- deformable rigid bodies under the static and dynamic conditions and apply them to some practical applications. The objective is also to provide the students with some physical insights into the mechanics to enable them to apply them during the study of subjects such as strength of materials , Theory of machines, Design etc.,

Course Outcomes:

The student will be able to

CO-1	Formulate the given physical problem into a mathematical model using the conditions of equilibrium, solve the mathematical model and elucidate the results back in terms of physics.
CO-2	Deal with the force systems in plane and Space and can locate the centroid of various composite sections.
CO-3	Obtain the internal axial forces in plane Frames/Trusses by the appropriate analytical methods.
CO-4	Apply the principle of Virtual work to determine the forces in planar systems.
CO-5	Analyze the Kinematics and Kinetics of particle motion in rectilinear and curvilinear coordinates.
CO-6	Apply the Newton's laws, D'Alembert principle, work-energy and impulse momentum relationships to solve the problems of Dynamics including the friction involved problems.
CO-7	Differentiate the particle and rigid body and then analyze the rigid body rotation and plane motion of rigid body.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1						1	
CO2	3	3	3	3	1							
CO3	3	3	3	2	1							
CO4	3	3	2	2	1							
CO5	3	3	2	2	1							
CO6	3	3	3	3	1							
CO7	3	3	2	2	1							

STATICS

Basic Concepts: Scalar and vector quantities- Representation vectors- Free vector force, Specification of force- Effect of force on rigid body- Free body diagram.

Concurrent Forces and Parallel Forces in a Plane: Principles of statics- Equilibrium of concurrent forces in a plane- Method of projections- Equilibrium of three forces in a plane- Method of moments- **Friction.** Two parallel forces- General case of parallel forces in a plane-Centre of parallel forces and centre of gravity- Centroids of composite plane figures and curves- Distributed force in a plane.

General Case of Forces in a Plane: Composition of forces in a plane- Equilibrium of forces in a plane- Plane trusses, Funicular polygon, Maxwell diagrams, method of joints, method of sections- Plane frame- method of members, Distributed force in a plane- Flexible suspension cables.

Force Systems in Space: Concurrent forces in space; method of projections, method of moments; Couples in space- Parallel forces in space- Centre of parallel forces and centre of gravity- General case of forces in space.

Principle of Virtual Work: Equilibrium of ideal systems- Efficiency of simple machines- Stable and unstable equilibrium.

DYNAMICS

Basic concepts: Kinematics- Kinetics- Newton laws of motion- Particle- Rigid body- Path of particle.

Rectilinear Translation: Kinematics of rectilinear motion Principles of dynamics- Differential equation of rectilinear motion- Motion of a particle acted upon by a constant force, Force as a function of time- Force proportional to displacement; free vibrations- D'Alembert's principle- Momentum and impulse- Work and energy- Ideal systems: conservation of energy. **Curvilinear Translation:** Kinematics of curvilinear motion- Differential equations of curvilinear- Motion of a projectile- D'Alembert's principle- Moment of momentum- work and energy in curvilinear motion.

Rotation of rigid body about a fixed axis: Kinematics of rotation- Equation of motion for a rigid body rotating about a fixed axis- Rotation under the action of a constant moment

Torsional vibration- The compound pendulum- General case of moment proportional to angle of rotation- D'Alembert's principle in rotation.

Plane Motion of a Rigid Body: Kinematics of plane motion- Instantaneous center- Equations of plane motion- D'Alembert's principle in plane motion- The principle of angular momentum in plane motion- Energy equation for plane motion.

Text Book:

1. Engineering Mechanics by S.Timoshenko and D.HYoung McGraw-Hill.

References:

1. Engineering Mechanics, Vol.2 by J.L. Meriems and L.G. Kraige.
2. Engineering Mechanics by Singer.
3. Engineering Mechanics by K.L. Kumar, Tata Mc-Graw Hill.
4. Engineering mechanics by Bhavikatti. New age international.

MEC 213 – MECHANICS OF SOLIDS-I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To identify the mechanical properties of a given material under the action of various types of loads.
- To identify the complex state of stresses induced in a given member subjected to and complex state of loads.
- To identify the behavior of different beams subjected to various loading conditions.
- To know the deflection of beams subjected to various loading conditions.
- To identify bending stresses induced in a beam subjected to pure bending.
- To identify torsional shear stresses induced in a beam subjected to twisting moment.
- To identify deflection of various springs under different loading conditions.
- To know the behavior of thin cylinders subjected to internal pressure.

Course Outcomes:

Students will be able to:

CO-1	Find various mechanical properties like yield strength, ultimate strength etc... Of a given material.
CO-2	Find out stresses induced in an inclined plane of a member subjected to complex state of loads.
CO-3	Find out shear force & bending moment variations at various cross sections of a beam Subjected to different loads..
CO-4	Find out deflection of a beam at various cross sections subjected to different loads.
CO-5	Find out bending stresses induced in a beam at different cross sections.
CO-6	Find out shearing stresses induced in a beam at different cross sections.
CO-7	Find out stresses & deflection induced in a spring due to various loading conditions.
CO-8	Find out stresses induced in a thin cylindrical shell subjected to internal pressure.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2				2		1	1
CO2	3	2	2		2				2		1	1
CO3	3	1	2		2				1		1	1
CO4	3	1	2		2				1		1	1
CO5	3	1	2		2				1		1	1

CO6	3	1	2		2				1		1	1
CO7	3	1	2		2				1		1	1
CO8	3	1	2		2				1		1	1

Simple Stresses: Stress, Strain, Stress- Strain curve, Lateral strain, Relationship between elastic constants, Bars of varying cross-section, Compound bars, Temperature stresses in bars. Complex Stresses: Stresses on an inclined plane under different uniaxial and biaxial stress conditions, Principal planes and principal stresses, Mohr's circle, Relation between elastic constants, Strain energy, Impact loading.
Bending Moments and Shear Forces: Beam - Types of loads, Types of supports, S.F. and B.M. diagrams for cantilever, Simply supported and over hanging beams.
Stresses in Beams: Theory of bending, Flexural formula, Shear stresses in beams.
Deflections of Beams: Relation between curvature, slope and deflection, double integration method, Macaulay's method, Moment area method.
Torsional Stresses in Shafts and Springs: Analysis of torsional stresses, Power transmitted, Combined bending and torsion, Closed and open coiled helical springs. Laminated springs.
Theories of Failure: Application to design of shafts.
Cylinders and Spherical Shells: Stresses and strains in thin cylinders, Thin spherical shell.

Text Book:
1. Analysis of Structures, by Vazirani and Ratwani, Vol. 1, 1993 edition.

Reference:
1. Strength of Materials, by Timoshenko

MEC 214 - ENGINEERING THERMODYNAMICS-I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To provide the student with a simplistic and practical approach to the fundamental subject of thermodynamics.
- To create an interest and intuitive understanding of the nuances of this core subject which deals with energy and its different forms.
- To make the student have firm grasp of this interesting subject so that any real time engineering problem encountered can be solved with ease.

Course Outcomes:

The student will be able to:

CO-1	Have a clear understanding of the two approaches to a problem-microscopic and macroscopic.
CO-2	Designate a system and study its interaction with the surroundings in the form of mass and/or energy transfer and its effect on the system thermodynamic coordinates.
CO-3	Have a thorough grip on basic laws of thermodynamics i.e., zeroth law, first law (principle of conservation of energy) and second laws.
CO-4	Apply the theoretical principles to the working of heat engines, heat pumps and refrigerators and evaluate their performance.
CO-5	Understand the concepts of ideal process(reversible process) and causes of Irreversibility.
CO-6	Handle various flow and non-flow process and analyze them.
CO-7	Understand the concept of availability and differentiate between first and second law efficiencies.
CO-8	Appreciate the significance of Power cycles on which the heat engines are driven and compare the relative merits and demerits.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3		1			1				1	1
CO-2	3	3	3	2			1			1	1	1
CO-3	3	3	2	2	1	1	1			1		
CO-4	3	3	3	3	1	3	2			1	1	
CO-5	3	3	3	2	1	1	2	1	1			
CO-6	3	2	3	2	1		1			1		
CO-7	1	3	3	3	1	2	1			2	2	2
CO-8	3	3	2	2	2	1	1		1			2

Introduction: Basic concepts; Thermodynamic systems; Micro & Macro systems; Homogeneous and heterogeneous systems; Concept of continuum; Pure substance; Thermodynamic equilibrium; State; Property; Path; Process; Reversible and irreversible cycles; Work; Heat; Point function; Path function; Heat transfer.

Zeroth law of thermodynamics; Concept of equality of temperatures- Joule's experiments- First law of thermodynamics- Isolated systems and steady flow systems- Specific heats at constant volume and pressure - Enthalpy- First law applied to flow systems- Systems undergoing a cycle and change of state- First law applied to steady flow processes- Limitations of first law of thermodynamics.

Perfect gas laws- Equation of state- Universal gas constant, various non-flow processes- Properties of end states- Heat transfer and work transfer- Change in internal energy-throttling and free expansion- Flow processes- Deviations from perfect gas model-Vanderwall's equation of state- Compressibility charts- Variable specific heats.

Second law of thermodynamics- Kelvin Plank statement and Clasius statement and their equivalence, Corollaries- Perpetual motion machines of first kind and second kind- Reversibility and irreversibility- Cause of irreversibility- Carnot cycle- Heat engines and heat pumps- Carnot efficiency- Clasius theorem- Clasius inequality- Concept of entropy- Principles of increase of entropy- Entropy and disorder.

Availability and irreversibility- Helmholtz function and Gibbs function- Availability in steady flow- Entropy equation for flow process- Maxwell's equations- Tds relations- Heat capacities.

Air standard cycles-Air standard efficiency- Otto cycle-Diesel cycle- Dual cycle- Brayton cycle- Atkinson cycle- Stirling cycle- Erickson cycle

Text Books:

1. Engineering Thermodynamics, by P.K. Nag, Tata McGraw-Hill Publications Company.
2. Applied Thermodynamics-I by R. Yadav, Central Book House.
3. Engineering Thermodynamics by K. Ramakrishna, Anuradha agencies.

References Books:

1. Engineering Thermodynamics by Rathakrishnan, Prentice - Hall India.
2. Engineering Thermodynamics by Y.V.C. Rao.
3. Thermal Engineering by R.K. Rajput, S.Chand & Co.
4. Engineering Thermodynamics Work and Heat Transfer, by G.F.C Rogers and Y.R. Mayhew, ELBS publication
5. Engineering Thermodynamics by Zemansky.

MEC 215 – MACHINE DRAWING

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 4 Drawing Ses. : 30 Exam : 70

Examination : 3hrs. Credits : 4

(Common to Mechanical and MPIE)

Course Objectives:

- To teach students about sectional views and how represent internal parts of machine elements.
- To introduce standards about Screw threads and Screwed Fasteners and their standard Empirical formulae. Various Permanent joints such as Riveted joints and Welded Joints.
- To teach students about To teach students about temporary fasteners like Keys, Cotter- joints, Pin-joints, and different types of couplings and shaft bearings.
- To educate students about assembly drawings and production drawings of various components and machine tool components.
- To give make understand process sheets, stock strip layouts in sheet metal drawing for analysis of problems in industry.

Course Outcomes:

Upon completion of the subject, students will be able to

CO-1	Understand the drawings of mechanical components and their assemblies along with their utility for design of components
CO-2	Draw various couplings, joints and pins. Different types of threads and fastenings and they can draw them on the sheet with dimensions.
CO-3	Understand process sheets, stock strip layouts in sheet metal drawing.
CO-4	Recognize the importance and value of production drawings in industry.
CO-5	Skillfully use modern engineering tools and techniques such as CAD- CAM softwares for mechanical engineering design, analysis and application

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	2	3	3	3	2	2	3	2	3	1	3
CO-2	2	1	-	2	3	-	-	3	2	3	2	-
CO-3	2	3	3	1	2	2	-	2	2	3	1	2
CO-4	3	3	3	2	-	2	-	3	3	3	3	2
CO-5	2	3	3	3	3	2	3	2	2	2	1	3

Screw threads and Screw Fastenings using standard Empirical formulae.
Riveted joints, Keys, Cotter-joints, Pin-joints.
Shaft couplings: Box and split muff couplings, Flanged, Flexible, Universal and Oldham couplings,
shaft bearings, Brackets and Hangers, Pipe joints.
Orthogonal views and Sectional views of machine parts.
Assembly drawing of various engine components and machine tool components.

Text Books:

1. Machine Drawing, by N.D.Bhatt, Charotal Publishing House.
2. Engineering Drawing, by A.C.Parkinson, Wheeler Publishing.

Reference:

1. Machine Drawing by K.L Narayan, P. Kannaiah and K. Venkata Reddy, New Age.

MEC 216 - MANUFACTURING TECHNOLOGY-I
(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

Course Objective:

To make the students learn about fundamental manufacturing concepts and understand various manufacturing processes such as casting, forming and joining.

Course Outcomes:

Students will able to:

CO-1	Students will able to acquire basic principles of manufacturing process like casting, forming and welding.
CO-2	Students will learn about mould making and various components involved in it.
CO-3	Students will understand the procedure for designing various dies used in forming process.
CO-4	Students will be able to analyze the defects in casting, forming and welding process.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2							1	2		1	
CO2		3	2	2				1	2		1	
CO3	2		3					1	2		1	
CO4		3	2	1				1	2		1	

Manufacturing concepts; Product cycle; Job, batch and mass production; Primary and secondary manufacturing processes; Principle of metal casting; Terminology; Pattern; Types; Allowances; Materials; Core boxes; Selection; Testing and preparation of moulding sands; Moulding tools and equipment; Machine moulding; Core making; Sprue; Runner, gates and risers; Types and designing; Melting and pouring the metal; Shell mold casting; Investment casting; Permanent mould casting; Casting defects.

Formability of metals; Cold and hot working; Rolling; Types; Roll size; Stretch forming, metal spinning, embossing and coining; Peening; Sheet metal forming operations; Presses; Die design.

Forging materials; Forging processes; Forging techniques; Forging presses; Forging pressure distribution and forging force; Automation of forging; Swaging; Drawing; Extrusion; High energy rate forming.

Weldability; Welding metallurgy; Principles and processes of arc welding (SMAW, GTAW, GMAW, FCAW, PAW, SAW); Welding equipment; Weld positioners and fixtures; Oxyacetylene welding; Flame cutting; Brazing and soldering; Principle of resistance welding; Types of resistance welds; Seam welding; Projection welding; Resistance butt welding; Solid state welding; Weld inspection and testing.

Text Book:

1. Process and Materials of Manufacture (4^{th} Edition) by Roy A. Lindberg, Prentice-Hall of India Private Limited.

Reference Books:

1. Manufacturing Engineering & Technology by Kalpak Jain, Addition Wesley Edition.
2. Materials and Processes in Manufacturing by De Margo, Black and Kohsen, Prentice Hall of India.
3. Principles of Metal Casting by Hein and Rosenthol, Tata Mc-Graw Hill India.
4. Manufacturing Technology-Foundary, Forming and Welding by P.N. Rao, Tata McGraw-Hill Publishing Company.

MEC 217 - STRENGTH OF MATERIALS LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination : 3hrs. Credits : 2

Course Objectives:

- To identify the mechanical properties of a given material under the action of various types of loads.
- To identify the shear stresses induced in a given member subjected to twisting moment.
- To identify the behavior of a given specimen subjected to impact loading.
- To identify the deflection of a simply supported & cantilever beam subjected to point loads..
- To perform sieve analysis on a given sand sample.
- To perform optimum selction of configuration for bulking of sand.
- To identify deflection of spring under a compressive load.
- To identify the hardness of a given material by using
  a. Vickers hardness test.
  b. Rockwell& Brinell hardness test

Course Outcomes:
Students will be able to:

CO-1	Find various mechanical properties like % elongation, yield strength, ultimate strength, etc... Of a given material by conducting a simple tension test on Universal testing machine.
CO-2	Find out shear stresses induced member subjected to twisting moment on a torsion testing machine.
CO-3	Find out the energy absorbed by the specimen subjected to impact loading.
CO-4	Find out modulus of elasticity of a given beam subjected to point loads.
CO-5	Find out grain fineness number using sieve shaker.
CO-6	Find out maximum bulking of sand to mix appropriate percentage of cement and sand for construction purpose.
CO-7	Find out modulus of rigidity of given spring material on spring testing machine.
CO-8	Find out VHN, BHN &RHN of given mild steel and brass specimens subjected to different values of loads.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	1	2		2				1		1	1
CO2	3	1	2		2				1		1	1
CO3	3	1	2		2				1		1	1
CO4	3	1	2		2				1		1	1
CO5	3	1	2		2				1		1	1
CO6	3	1	2		2				1		1	1
CO7	3	1	2		2				1		1	1
CO8	3	1	2		2				1		1	1

List of Experiments:

1. To study the stress strain characteristics (tension and compression) of metals by using UTM.
2. To study the stress strain characteristics of metals by using Hounsefield Tensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickers and Rockwell's.
5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
10. Bulking of sand.
11. Punch shear test, hardness test and compression test by using Hounsefield tensometer.
12. Sieve Analysis and determination of fineness number.

MEC 218 - MECHANICAL ENGINEERING LAB – I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination : 3hrs. Credits : 2

Course Objective:

To Demonstrate and perform experiments on Fuels & lubricants on properties such as flash point, fire point, viscosity, calorific values etc., Calibration of Pressure gauge, volumetric efficiency of single stage air compressor, mass moment of inertia of connecting rod.

To study of valve timing and port timing diagrams of petrol and diesel engines, various boiler models, their mountings and accessories

Outcomes:

Upon successful completion of this lab, the students will be able to:

CO-1	Measure flash and fire point of various liquid fuels.
CO-2	Measure viscosity of various lubricating oils under various temperatures & mass moment of inertia of connecting rod.
CO-3	Calibrate Pressure gauge.
CO-4	Understand valve and port open and closer timings of 4-stroke and 2-stroke engines.
CO-5	Measure volumetric efficiency of reciprocating air compressor.
CO-6	Understand the working of various boilers.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1				3		1				1		
CO-2				3			2			1		
CO-3				2						1		
CO-4	1	1	1							1		
CO-5				3						1		
CO-6	1	1	1				3			1		

List of Experiments:

1. Study and valve timing diagrams for four-stroke and study & PTD of two-stroke engines.
2. Determination of volumetric efficiency of the given air compressor by (i) plate orifice method and (ii) tank capacity method.
3. Calibration of the given pressure gauge.
4. a) Determination of flash and fire points and
   b) Canradsons carbon residue test.
5. Determination of calorific value of flues (solid, liquid and gaseous) by Bomb calorimeter/Gas calorimeter.
6. Determination of the kinematic and absolute viscosity of the given sample oils.
7. Determination of inertia of the given flywheel and connecting rod.

8. Determination of modulus of rigidity of the given wire with torsion pendulum.
9. Study of boilers, various mountings and accessories.
10. Assembling of the given two-stroke petrol engine. (Instead of engine, any mechanical unit can be given for this experiment.)

B.E. (MECH.) - II/IV
(II-SEMESTER)
MEC 221 - MATHEMATICS-IV

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

(Common for ALL braches except Chemical Engineering)

Course Objective:

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering

Course Outcomes:

Students will be able to

CO1	Solve Analytical function & Complex integration
CO2	Apply methods of Numerical Computation for real time problems
CO3	Analyze the Statistical data by using statistical tests (based on small sample and large sample)
CO4	Draw valid inferences based on the analysis of statistical data

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		1							1	
CO2	1		1	1	3						2	1
CO3	1	1		1	1	2	2				1	
CO4	1	1		1	1	2	2				1	

Functions of a Complex Variable: Continuity concept of f(z); derivative of f(z); Cauchy-Riemann equations; Analytic functions; Harmonic functions; Orthogonal system; Applications to flow problems; Integration of complex functions; Cauchy's theorem; Cauchy's integral formula; Statements of Taylor's and Laurent's series without proofs; Singular points; Residues and residue theorem; Calculation of residues; evaluation of real definite integrals; Geometric representation of f(z); Conformal transformation; Some standard transformations: (1) $w = z = c$, (2) $w = 1/z$, (3) $w = (az + b)/(cz + d)$, (4) $w = z^2$ and (5) $w = e^z$.

Statistical Methods:

1. Review of probability theory (not to be examined): Addition law of probability; Independent events; Multiplication law of probability; Bay's theorem; Random variable; Discrete probability distribution; Continuous probability distribution; Expectation; Moment generation function; Repeated trials; Binomial distribution; Poisson distribution; Normal distribution; Probable error; Normal approximation to Binomial distribution.
2. Sampling theory: Sampling distributions; Standard error; Testing of hypothesis; Level of significance; Confidence limits; Simple sampling of attributes; Sampling of variables:

Large samples and small samples; Student's t-distribution; x -distribution; F-distribution; Fisher's Z-distribution.

Difference Equations and Z-Transforms: Z-transform; Definition; Some standard Z-transforms; Linear property; Damping rule; Some standard results; Shifting rules; Initial and final value theorems; Convolution theorem; Evaluation of inverse transforms; Definition; Order and solution of a difference equation; Formation of difference equations; Linear difference equations; Rules for finding C.F.; Rules for finding P.I.; Difference equations reducible to linear form; Simultaneous difference equations with constant coefficients; Application to deflection of a loaded string; Application of Z-transforms to difference equations.

Text Book:

1. Higher Engineering Mathematics, (34^{th} edition 1998) by B.S. Grewal.

Reference Books:

1. A Text Book on Engineering Mathematics by N.P. Bali et al.
2. Higher Engineering Mathematics by M.K. Venkataraman.
3. Advance Mathematics for Engineering Students, Vol. 2 & Vol. 3 by Naryanan et al.
4. Advanced Engineering Mathematics by Erwin Kreyszig.
5. Engineering Mathematics by P.P. Gupta.
6. Advanced Engineering Mathematics by V.P.Jaggi and A.B.Mathur.
7. Engg. Maths, by S.S.Sastry, Printice-Hall of India, Pvt.Ltd., New Delhi-6.
8. Advanced Engineering Mathematics by H.K. Dass.
9. Engineering Mathematics Vol. 2 by Tarit Majumdar.

MEC 222 – MATERIALS SCIENCE

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

To make students understand the fundamental concepts of material science, space lattice, phase diagrams; Plastic deformation; classification of steels; Composite materials and NDT methods.

Course Outcomes:

Students will be able to:

CO-1	Select materials for various design and construction purpose.
CO-2	Gain knowledge of fundamental structures of materials and their properties.
CO-3	Gain pre-requisite knowledge for core subjects like Design of Machine elements for selection of any material for the design analysis.
CO-4	Understand the characteristics of materials as they were used in manufacturing processes.
CO-5	Use experimental methods to test and analyze the behavior of materials and properties of the materials.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	3	3	2		1				2	2
CO-2	3	1		2	2		1				1	1
CO-3	1	1	3	3	1		1				1	
CO-4	3	3	3	3	2		2				1	1
CO-5	2	2	3	2	1	1	2	1			1	

Space Lattice and unit cells, crystal systems. Indices for planes and directions. Structures of common metallic materials. Crystal defects: point, line and surface defects.

Binary Phase Diagrams. Gibbs rule. Lever rule. Invariant reactions. Iron-iron carbide phase diagram. Heat treatment of steel. Isothermal transformations curves. Annealing, Normalizing, Hardening, Tempering, Austempering and Martempering of steels. Surface hardening of steels. Carburizing, Nit riding, Cyaniding, Flame and induction hardening methods.

Classification of Steels, I.S., AISI-SAE classifications. Uses and limitations of plain-carbon steels, alloy steels. Plain carbon and low alloy steels. Tool steels. Stainless steels. Cast irons. Gre, White, Malleable and SG irons, Alloy cast irons. Non-ferrous metals and alloys: Brasses and Bronzes, Bearing metals.

Plastic Deformation: Slip, Twining critical resolved shear stress. Ductile and Brittle fracture. Mechanism of creep and fatigue. High temperature alloys. Metals at low temperature. Effect of low temperature on properties: Low temperature metals.

Composite Materials. Classification. Matrices and reinforcements. Fabrication methods. Examples and applications.
NDT Testing: Ultrasonic, Magnetic, Dye penetrant and visual methods and applications radiographic.

Text Books:
1. Material Science and Engineering by V. Raghavan.
2. Physical Metallurgy by S.H. Avner.

Reference Books:

1. Material Science and Engineering by L.H.Van Vleck, 5th edition, Addison Wealey (1985).
2. Structure and Properties of Materials by R.M. Rose, L.A. Shepard and J. Wulff, Vol.1, 4 John Willey (1966).
3. Essentials of Material Science by A.G. Guy, McGraw-Hill (1976).
4. The Science and Engineering Materials by D.R. Askeland, 2nd edition, Chapman and Hall (1990).

MEC 223 – ENVIRONMENTAL SCIENCE

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

(Common to ALL branches)

Course Objectives:

This Course aims the students

- To provide knowledge on Environment and structure and functions of various ecosystems
- To know the importance of renewable energy sources as alternative to non renewable.
- To provide social and ethical values of biodiversity and need of its conservation
- To understand different ways pollution of environment and its consequences
- To create awareness on local and global issues
- To enlighten the students on various environmental legislative acts

Course Out comes:

At end of the course the student

CO-1	Able to adopt the suitable technologies for sustainable development
CO-2	Able to identify and solve the local environmental problems .
CO-3	Develop ability to create awareness on environmental aspects to society at large.
CO-4	Helps in solving scientific problems by adopting green technologies.
CO-5	Student able to play a vital role designing and developing a better society.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3			2	2	1		1		1
CO2			3			2	2	1		1		1
CO3			3			2	2	1		1		1
CO4			3			2	2	1		1		1
CO5			3			2	2	1		1		1

UNIT-I

Introduction Definition, Score and importance, Need for public awareness.

Ecosystems Introduction, Types, Characteristic features, Structure and functions of ecosystems, Forest, Grassland, Desert, Aquatic (lakes, rivers and estuaries).

UNIT-II

Environment and Natural Resources Management

Land Resources: Land as a resource, Common property resources, land degradation, Soil erosion and desertification, Effects of modern agriculture, fertilizer pesticide problems, Forest Resources : Use and over-exploitation, Mining and dams– their effects on forest and tribal people, Water resources : Use and over-utilization of surface and ground water, Floods,

Droughts, Water logging and salinity, Dams –benefits and costs, Conflicts over water, Energy Resources : Energy needs, Renewable and non-renewable energy sources, Use of alternate energy resources, Impact of energy use on environment .

UNIT-III

Bio-Diversity and its Conservation

Value of bio-diversity – Consumptive and productive use, Social, Ethical, Aesthetic and option values, Bio-geographical classification of India – India as a mega diversity habitat, Threats to biodiversity – Hot-sports, habitat loss, poaching of wildlife, loss of species, seeds etc., Conservation of biodiversity – in – situ and exsitu conservation.

Unit-IV

Environmental Pollution – Local and Global Issues

Causes, Effects and control measures of : Air pollution, Indoor air pollution, Global warming, Acid rain, Ozone depletion, Water pollution, Soil pollution, Marine pollution, Noise pollution, Solid waste management, Compositing, Vermiculture, Urban and industrial wastes, Recycling and re-use, Nature of thermal pollution and nuclear hazards,

Environmental legislation: Water (Prevention and control of pollution) act, air (Prevention and control of pollution) act, Environmental Protection Act, Wild life protection act, Forest conservation act, Costal zone regulations.

International Conventions

Stockholm Conference 1972, Earth Summit 1992, World Commission for Environmental Development (WCED

Unit-V

Social issues & Human population and environment

Sustainability: Theory and practice, Limits to growth. Environmental impact assessment.

Urbanization, Transportation, Industrialization, Green revolution, Resettlement and rehabilitation of people problems and concerns, Rain water harvesting, Cloud seeding and watershed management.

Population growth and environment, Environmental education, Environmental movements,- Chipko movement, Narmada bachao andolan, Silent valley project, Madhura refinery and Taj Majal, Tehri Dam, Ralegaon Siddhi (Anna Hazare), Kolleru lake – Acquaculture, Florosis in Andhra Pradesh.

Unit-VI

Field Work

Visit to a local area to document and mapping environmental assets – River / forest / grassland / hill / mountain, Study of local environment – Common plants, Insects, Birds, Study of simple ecosystems – Pond, river, hill, slopes etc. Visits to industries, Water treatment plants, and Affluent treatment plants.

Textbooks:

1. Kaushik – Kaushik, Anubha

Reference:

1. Deswal & Deswal, Raja Gopal, Dharmaraj Publishers.

MEC 224 – ELECTRICAL TECHNOLOGY

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To make students learn the analysis of circuits by using KCL & KVL.
- To teach students the operation and applications of DC & AC machines
- To teach students the principle of operation of various indicating instruments

Course Outcomes:

Students will be able to:

CO-1	Solve the circuits by using Basic theorems.
CO-2	Understand the working principle of AC/DC machines
CO-3	Find the regulation of Alternator and single phase transformer
CO-4	Understand the working principle of indicating instruments.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1								1		1	
CO2	1			1					1		1	
CO3	1			1					1		1	
CO4	1			1					1		1	

Magnetic Circuits: Definitions of magnetic circuit, Reluctance, Magnetomotive force (m.m.f), Magnetic flux, Simple problems on magnetic circuits, Hysteresis loss.

Electromagnetic Induction: Faraday's laws of Electromagnetic induction, Induced E.M.F., Dynamically induced E.M.F., Statically induced E.M.F., Self inductance, Mutual inductance.

D.C. Generators: D.C. generator principle, Construction of D.C. generator, E.M.F. equation of D.C. generator, Types of D.C. generators, Armature reaction, Losses in D.C. generator, Efficiency, Characteristics of D.C. generators, Applications of D.C. generator.

D.C. Motors: D.C. motor principle, Working of D.C. motors, Significance of back E.M.F., Torque equation of D.C. motors, Types of D.C. motors, Characteristics of D.C. motors, Speed control methods of D.C. motors, Applications of D.C. motor. Testing of D.C. machines: Losses and efficiency, Direct load test and Swinburne's test.

A.C. Circuits: Introduction of steady state analysis of A.C. circuits, Single and balanced 3-phase circuits.

Transformers: Transformer principle, E.M.F. equation of transformer, Transformer on load, Equivalent circuit of transformer, Voltage regulation of transformer, Losses in a transformer, Calculation of efficiency and regulation by open circuit and short circuit tests.

Three Phase Induction Motor: Induction motor working principle, Construction of 3-phase induction motor, Principle of operation, Types of 3-phase induction motor, Torque equation of induction motor, Slip-torque characteristics, Starting torque, Torque under running

condition, Maximum torque equation, Power stages of induction motor, Efficiency calculation of induction motor by direct loading.

Alternator: Alternator working principle, E.M.F. equation of alternator, Voltage regulation by sync, impedance method.

Synchronous Motor: Synchronous motor principle of operation, Construction. Methods of starting of synchronous motor.

Electrical Measurements: Principles of measurement of current, voltage, power and energy. Types of Ammeters, Voltmeters, Watt-meters, Energy meters, Electrical conductivity meter. Potentiometer, Megger.

Text Book:

1. Elements of Electrical Engineering and Electronics by V.K. Mehta, S. Chand & Co.

Reference:

1. A First Course in Electrical Engineering by Kothari.

MEC 225 – THEORY OF MACHINES–I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

To familiarize students with basic types of mechanisms, pairs, degrees of freedom. The objective is also to make students learn to perform velocity and acceleration analysis on different mechanisms using graphical methods and perform dynamic force analysis on mechanisms and governor performance.

Course Outcomes:

Student will be able to

CO-1	Understand the concepts of various mechanisms, pairs and degrees of freedom.
CO-2	Analyze the velocity and accelerations of various mechanisms.
CO-3	Determine the torque transmitted by Hooke's joint.
CO-4	Solve practical problems related to Dynamic force analysis
CO-5	Design Governors for practical application.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3			2			2	2	2
CO2	3	3	3	3			2			2	2	2
CO3	1	1	1	2			1				1	1
CO4	3	3	3	3			2			2	2	2
CO5	3	3	3	2			2			2	1	1

Mechanisms and Machines: Introduction; Mechanism and machine; Rigid and resistant bodies; Link; Kinematic pair; Degrees of freedom; Classification of kinematic pairs; Kinematic chain; Linkage, mechanism and structure; Mobility of mechanisms; The four-bar chain; Mechanical advantage; Transmission angle; The slider-crank chain; Double slider-crank chain; Miscellaneous mechanisms.

Velocity Analysis: Introduction; Absolute and relative motions; Vectors; Additional and subtraction of vectors; Motion of a link; Four-link mechanism; Velocity images; Angular velocity of links; Velocity of rubbing; Slider-crank mechanism; Crank and slotted lever mechanism; Algebraic methods; Instantaneous center (I-center); Kennedy's theorem; Locating I-centers; Angular velocity ratio theorem; centrode.

Acceleration Analysis: Introduction; Acceleration; Four-link mechanism; Four-link mechanism; Acceleration of intermediate and offset points; Slider-crank mechanism; Corriolis acceleration component; Crank and slotted lever mechanism; Algebraic methods; Klein's construction; Velocity and acceleration from displacement-time curve.

Lower Pairs: Introduction; Pantograph; Straight line mechanisms; Engine indicators; Automobile steering gears; Types of steering gears; Hooke's joint; Double Hooke's joint.

Friction: Introduction; Kinds of friction; Laws of friction; Coefficient of friction; Inclined plane; Screw threads; Wedge; Pivots and collars; Friction clutches; Rolling friction; Antifriction bearings; Greasy friction; Greasy friction at a journal; Friction axis of a link; Film friction; Mitchell thrust bearing.

Dynamic Force Analysis: Introduction; D'Alembert's principle; Equivalent offset inertia force; Dynamic analysis of four-link mechanism; Dynamic analysis of slider-crank mechanism; Velocity and acceleration of piston; Angular velocity and angular acceleration of connecting rod; Engine force analysis; Turning moment on crankshaft; Dynamically equivalent system; Inertia of the connecting rod; Inertia force in reciprocating engines (Graphical method); Turning-moment diagrams; Fluctuations of energy; Flywheels.

Governors: Introduction; Types of governors; Wait governor (simple conical governor); Portor governor; Proell governor; Hartnell governor; Hartung governor; Wilson-Hartnell governor (radial-spring governor); Pickering governor; Spring-controlled gravity governor; Inertia governor; Sensitiveness of a governor; Hunting; Isochronism; Stability; Effort of a governor; Power of a governor; Controlling force.

Text Book:

1. Theory of Machines by R.S.Khurmi & J.K.Gupta

Reference books:

1. Theory of Machines by Thomas Bevan.
2. Theory of Machines by S.S. Rattan.

MEC 226 - MANUFACTURING TECHNOLOGY-II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objective:

To demonstrate basic concepts of metal cutting, tool nomenclature and standards. To learn about tool performance factors and their monitoring. Able to understand the basic parts of lathe, drilling, milling and other machining processes. To acquire knowledge about non conventional machining process and understand their advantage over conventional machining processes.

Course Outcomes:

Students will able to:

CO-1	Students will able to obtain knowledge about metal cutting tools and their geometry and various standards followed in metal cutting.
CO-2	Students will understand the components of lathe, drilling and milling machines and acquire knowledge about nontraditional machining processes.
CO-3	Students will learn about specification of grinding wheel and other finishing process.
CO-4	Students will know latest nontraditional machining process and their applications.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	3	3	2			1	2		1	
CO2	3		3	3	2	1		1	2		1	
CO3	2	3	3	3	1			1	2		1	
CO4	2		3	3	3			1	2		1	

Mechanics of Metal Cutting; Chip formation & Types; Machinability; Tool materials; Tool geometry and tool signature ASA&ISO systems; Tool wear and tool life; Cutting forces and power; Measurement of forces and temperatures; Metal cutting economics; Cutting fluids.

Engine lathe; Operations; Turret and capstan lathes; Turning center; Boring machine and operations; Shaper, planner and slotter; Types; Operations; Mechanisms.

Drill geometry and cutting actions; Special drills; Drill forces and power-drilling speeds & feeds; Torque & thrust calculation; Drilling machines; Features and operations; Milling process; Milling cutting geometry; Cutting speed, feed, time and power in milling; Types of milling machines; Machining center; Broaching; Types; Tools; Machines; Broach time.

Principle; Operations; Grinding wheel manufacturing and marking balancing; Truing and dressing of grinding wheel; Grinding wheel selection; Grinding force; Grinding machines.
Abrasive belt machining; Lapping, honing and super finishing; Electro polishing and buffing.
Equipment; Process; Characteristics; Advantages; Limitations; Applications of chemical milling; Photochemical milling; EDM-computer controlled-traveling wire; ECM; AJM; LBM; EBM; WJM.

Text Book:

1. Process and Materials of Manufacture (4^{th} Edition) by Roy A. Lindberg, Prentice-Hall of India Private Limited.

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools by Geoffrey Boothroyd, International Student Edition, Mc Graw-Hill Book Company.
2. Metal Cutting Principles by M.C. Shaw, MIT Press, Cambridge.
3. Advanced Methods of Machining by J. A. Mc Geough, Chapman & Hall Publishers.
4. Metal Cutting-Theory and Practice by Amitabha Bhattacharya, Central Book Publishers.
5. Production Engineering by P.C. Sharma, S. Chand and Company.

MEC 227 - MANUFACTURING TECHNOLOGY LAB – I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination : 3hrs. Credits : 2

Course Objective:

To demonstrate various operations on lathe, milling and shaping, prepare butt joint and lap joint using manual arc welding and prepare sand mould using different patterns.

Course Outcomes:

CO-1	Students will able to operate lathe such as facing, turning, taper turning etc.
CO-2	Students will understand the operation of lathe, milling, drilling and shaping machine.
CO-3	Students will be able to perform manual arc welding of mild steel using lap joint and butt joint.
CO-4	Students will be able to prepare sand mould and understand various components involved in it.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			3	2	3		2	3		3	
CO2	2			3	2	3		2	3		3	
CO3	2			3	2	3		2	3		3	
CO4	2			3	2	3		2	3		3	

List of Experiments:

Use of basic tools and operations of the following trades.

S. No.	Trade	No. of exercises
1.	Foundry	3
2.	Welding	2
3.	Lathe Step and taper turning Thread cutting Offset turning	1 1 1
4.	Milling	1 (Spur gear)
5.	Shaper	1

6. Cylindrical grinding, Surface grinding, Planing, Slotting and Capstan lathe (only demonstration in one class for the entire batch of students).
7. Dissembling and assembling of *
   i. Machine Tool (Lathe)
   ii. I.C. engine
   iii. Pump
   iv. Gear box

* Not for examination.

MEC 228 - ELECTRICAL ENGINEERING LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination : 3hrs. Credits : 2

Course Objectives:

To make students learn:

- To calibrate wattmeter and energy meter
- To do practical analysis of linear circuits by using mesh and model analysis
- To do practical analysis of DC & AC machines

Course Outcomes:

Students will be able to:

CO1. Do analysis of linear circuits by using network theorem.
CO2.Predict the performance characteristics of DC machines, single phase transformer and induction motor
CO3. Predict the regulation of single phase transformer & alternator.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2	1		1	
CO2	1			1				2	1		1	
CO3	1			1				2	1		1	

List of Experiments:

1. Study and Calibration of wattmeter and energy meter.
2. Measurement of armature resistance, field resistance and filament resistance.
3. Verification of KCL and KVL.
4. Superposition theorem.
5. Parameters of a choke coil.
6. O.C. and S.C. tests on transformer.
7. Load test on D.C. shunt machine.
8. O.C. test on D.C. separately excited machine.
9. Swinburnes test.
10. 3 phase induction motor (No load and rotor block tests) load tests.
11. Alternator regulation by Syn. Impedance method.

B.E. (MECH.) - III/IV-(I-SEMESTER)
MEC 311 – INDUSTRIAL ELECTRONICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70
Examination (Theory): 3hrs. Credits : 4

Devices: Semi-conductor diode, Zener diode - Transistor - Silicon control rectifier. Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.

Industrial Applications: Poly-phase rectifiers - Control circuits - Motor speed control voltage control, Time delay relay circuits - Photo electric circuits. Resistance welding, inducting heating - Dielectric heating.

Servomechanism: Open loop and closed loop systems (Elementary treatment only).

Introduction to Digital Electronics: Fundamentals of digital electronics, Number system and codes, Logic gates, Boolean algebra, Arithmetic-logic units, Flip-flops, Registers and counters, Memories: ROM, PROM, EPROM and RAM.

Introduction to Microprocessors: The Intel-8085 microprocessor; Architecture, Instruction set, Execution of instructions, Addressing structures, Timing and machine cycles of 8085 and programming I/O operations, Interrupts, Serial input and serial output, Programming the I/O ports, Programming the timer.

Text Books:

1. Industrial Electronics by Mithal (Khanna Publications).
2. Digital Computer Electronics - An Introduction to Micro Computer by Albert Paul Malvino, Tata McGraw-Hill Publishing Co. Ltd., New Delhi-2.

References:

1. Engineering Electronics by Ryder-McGraw Hill.
2. Micro Processors by Leventhal.
3. Industrial Electronics by Bhatacharya, Tata Mc-Graw Hill.
4. Industrial Electronics and Control by S.K. Bhatacharya and S. Chatarjee, 1995 Ed., Tata Mc-Graw Hill Pub. Co. Ltd.

MEC 312 – MECHNICS OF SOLIDS – II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

The objective is to make students learn and analyze continuous and fixed beams, columns and struts under different loading conditions, stresses in rotating discs, curved bars, thin and thick shells.

Course Outcomes:

The students will be able to:

CO-1	Understand the advanced concepts of strength of materials like curved bars, applications of theories of failures in the design of thick cylindrical vessels and pressure vessels etc.
CO-2	Analyze the effect of various loading conditions on a mechanical/structural member.
CO-3	Analyze and design columns, long mechanical members under compression and pressure vessels.
CO-4	Develop an understanding of methods of analysis used in treating statically indeterminate loading conditions of the beams.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1	3	3	1	2					2	1	3
CO-2		3	2	1							2	1
CO-3	2	3	3	3	2						3	
CO-4	3	2	3							2		2

Fixed Beams: Fixing moments for a fixed beam of uniform and variable sections, Effect of sinking support, slope and deflection.

Continuous beams: Analysis of continuous beam, Reactions at the supports, Effect of sinking of supports.

Energy Methods - Castigliano's theorems I & II applications.

Columns and Struts: Columns with one end free and the other fixed, Both ends fixed, One end fixed and other hinged, Limitation of Euler's formula, Column with initial curvature, Column carrying

eccentric load, Laterally loaded columns with Central point load and Uniformly distributed load, Empirical formulae.

Bending of Curved Bars: Stresses in bars of circular, rectangular and trapezoidal sections.

Stresses due to rotation: Wheel rim, disc of uniform thickness, disc of uniform strength.

Thick cylinders subjected to internal and external pressure and compound cylinders.

Text Books:

1. Analysis of Structures, Vol. 1, 1993 edition, by Vazirani and Ratwani.
2. Chapter VI from Advanced Topics in Strength of Materials, by Prof. L.B.Shah and Dr.R.T.Shah.

References:

1. Strength of Materials, by Timoshenko.

MEC 313 ENGINEERING THERMODYNAMICS – II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To introduce the concepts involved in the formation of steam its properties and applications.
- To give an insight into the thermodynamic cycles on which steam power plants function and also the methods of improving its performance.
- To provide the students with a knowledge based on different types of steam turbines, their function and their relatives merits and demerits.
- To give an expose on nozzles, their applications and thermodynamic analysis of their working.
- To impart the student about the importance of a condenser in steam power plant and also the factors which retrograde its functioning and also overall view on evaluating its performance.

Course Outcomes:

The student will be able to

CO-1	Delineate the types of steam turbines and the mechanical principles involved and their functioning.
CO-2	Represent the phenomena of formation of steam on a thermodynamic chart using any properties.
CO-3	Use steam tables and moller diagram for reading the properties of steam and use them in solving problems of thermodynamic process involving steam.
CO-4	Understand and explain the vapor power cycles including the significance of reheating and regeneration and the effect of thermodynamic variables on their performance.
CO-5	Select and design a nozzle for a given application based on the principles he has studied.
CO-6	Analyze the functioning of steam turbine both thermodynamically and mechanics point of view and also draw velocity triangles their off.
CO-7	Identify the problems associated with the malfunctioning of condenser and devise ways of rectifying them.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1	1	1	2	1	1						
CO-2	2				1							1
CO-3	2	2	1	1								
CO-4	2	3	3	2	1		1		1	1		1
CO-5	1	2	2	2	1							1
CO-6	3	2	2	2	2	1	1		1	1	1	1
CO-7	1	3	1	1	1	1	2	1		1	2	1

Properties of Pure Substance: Definition of pure substance, phase change of a pure substance, p-T (Pressure-Temperature) diagram for a pure substance, p-V-T(Pressure-Volume-Temperature) surface, phase change terminology and definitions, property Diagrams in common use, Formation of steam, Important terms relating to steam formation, Thermodynamic properties of steam and steam tables, External work done during evaporation, Internal latent heat, Internal energy of steam, Entropy of water, Entropy of evaporation, Entropy of wet steam, Entropy of superheated steam, Enthalpy-Entropy (h-s) charts for Mollier diagram, Determination of dryness fraction-Tank or bucket calorimeter, throttling calorimeter, separating and throttling calorimeter.

Gases and Vapour Mixtures and Vapor Power Cycles : Introduction, Daltons law and Gibbs-Dalton law, Volumetric Analysis of gas mixtures, Apparent molecular weight and gas constant, specific heats of gas mixture, Adaibatic mixing of perfect gases, Gas and vapour mixtures.Vapor power cycle- Rankine cycle- Reheat cycle- Regenerative cycle- Thermodynamic variables effecting efficiency and output of Rankine and Regenerative cycles- Improvements of efficiency, Binary vapor power cycle.**Steam Nozzles**: Type of nozzles- Flow through nozzles- Condition for maximum discharge- Nozzle efficiency- Super saturated flow in nozzles- Relationship between area velocity and pressure in nozzle flow- Steam injectors.

Steam Turbines: Classification of steam turbines- Impulse turbine and reaction turbine- Compounding in turbines- Velocity diagrams in impulse and reaction turbines- Degree of reaction- Condition for maximum efficiency of reaction turbines- Effect of friction on turbines constructional features governing of turbines.

Condensers: Classification of condenser- Jet, Evaporative and surface condensers- Vacuum and its measurement- Vacuum efficiency- Sources of air leakage in condensers- Condenser efficiency- Daltons law of partial pressures- Determination of mass of cooling water- Air pumps.

Refrigeration: Bell Colemen cycle, Vapor compression cycle- effect of suction and condensing temperature on cycle performance, Properties of common refrigerants, Vapor absorption system, Electrolux refrigerator. Principles of psychrometry and Air conditioning - Psychrometric terms, psychrometric process, air conditioning systems.

Text Books:

1. A Treatise on Heat Engineering by Vasandhani and Kumar.
2. Applied Thermodynamics-II by R. Yadav.
3. Fundamentals of Engineering Thermodynamics by E. Radhakrishna, PHI.

References:

1. Thermal Engineering, by R. K. Rajput.
2. Fluid Flow Machines, by M.S. Govinda Rao, Tata McGraw Hill publishing company Ltd.
3. Refrigeration and Air-conditioning, by C.P.Arora and Domokundwar.
4. Thermal Science and Engineering by D.S. Kumar, S.K. Kataria and Sons
5. Refrigeration and Air-conditioning, by Ahamadul Ameen, PHI.

MEC 314 - THEORY OF MACHINES – II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To help students to understand the gyroscopic effect on vehicles, ships and planes.
- To make students analyze cam-follower motion, gears and gear train configurations
- To teach students the balancing procedures for rotating and reciprocating masses.
- To teach students the fundamentals of vibrations.

Course Outcomes:

Student will be able to

CO-1	Apply the knowledge of gyroscopic couple
CO-2	Solve practical problems related to gears and gear trains in industries..
CO-3	Design cams for any application
CO-4	Solve balancing problems in IC engines and automobiles.
CO-5	Analyze vibrations in engines.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3			2			2	2	2
CO2	2	2	2	2						2	2	1
CO3	3	3	3	3			2			2	2	2
CO4	3	3	3	3			2			2	2	2
CO5	3	3	3	2			2			2	2	2

Gyroscopic Couple and Precessional Motion: Precessional and angular motion- gyroscopic couple- effect of gyroscopic couple on an aero plane and on a naval ship, stability of a four wheel vehicle moving in a curved path, stability of a two-wheel vehicle taking a turn.

Cams: Classification of followers and cams- Definitions- Motions of the follower- Uniform velocity- Simple harmonic motion- Uniform acceleration and retardation- Displacement- Velocity and acceleration diagrams. Construction of cam profiles- Cam with knife edged follower and roller follower- Cams with specified contours- Tangent cam with roller follower- Circular arc cam with flat faced follower.

Toothed gearing: Classification of toothed wheels, technical terms, conditions for constant velocity ratio of toothed wheels- Law of gearing- Velocity of sliding of teeth, forms of teeth- Length of contact, arc of contact, interference in involute gears, minimum number of teeth required on pinion to

avoid interference- Methods of avoiding interference- Helical gears, Spiral gears- Efficiency of spiral gears.

Gear Trains: Types of gear trains- Simple, compound, reverted and epicyclic gear trains- Velocity ratio of epicyclic gear train- Tabular method- Algebraic method- Torques and tooth loads in epicyclic gear trains.

Balancing of Rotating and Reciprocating Masses: Balancing of a single rotating mass in the same plane and by two masses in different planes, balancing of several masses revolving in the same plane- Balancing of several masses revolving in different planes- Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary forces in a reciprocating engine, Partial balancing of locomotives- Effect of partial balancing of reciprocating parts of two cylinder locomotives- Variation of tractive force, Swaying couple and hammer blow- Balancing of primary and secondary forces in multi cylinder in-line engines- Direct and reverse cranks- Balancing of V-Engines.

Vibrations: Definitions- Types of vibrations- Natural frequencies of free longitudinal vibrations of systems having single degree of freedom- Equilibrium method- Energy method and Rayleghy's method. Frequency of damped vibration and forced vibration with damping- Magnification factor or dynamic magnifier.

Transverse and Torsional Vibrations: Natural frequency of free transverse vibrations due to point load and uniformly distributed load acting over a simply supported shaft- Transverse vibrations for a shaft subjected to number of point loads- Energy method- Dunkerley's method, Critical speed of a shaft. Natural frequency of free torsional vibrations- Free torsional vibrations of single rotor system, two rotor system, three rotor system and gear system.

Text Book:

1. Theory of Machines by R.S.Khurmi & J.K.Gupta.

Reference books:

3. Theory of Machines by Thomas Bevan.
4. Theory of Machines by S.S. Rattan.

MEC 315 - PRODUCTION DRAWING

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 3 Pr. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 2

Course Objectives:

- To teach students about sectional views and how represent internal parts of machine elements.
- To introduce standards about Screw threads and Screwed Fasteners and their standard Empirical formulae. Various Permanent joints such as Riveted joints and Welded Joints.
- To teach students about To teach students about temporary fasteners like Keys, Cotter- joints, Pin-joints, and different types of couplings and shaft bearings.
- To educate students about assembly drawings and production drawings of various components and machine tool components.
- To give make understand process sheets, stock strip layouts in sheet metal drawing for analysis of problems in industry.

Course Outcomes:

Upon completion of the subject, students will be able to

CO-1	Understand process sheets, stock strip layouts in sheet metal drawing.
CO-2	Recognize the importance and value of production drawings in industry.
CO-3	Skillfully use modern engineering tools and techniques such as CAD- CAM softwares for mechanical engineering design, analysis and application

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	3	3	1	2	2	-	2	2	3	1	2
CO-2	3	3	3	2	-	2	-	3	3	3	3	2
CO-3	2	3	3	3	3	2	3	2	2	2	1	3

Introduction to Production drawing, Component drawing, Assembly drawing, Machine shop drawing, Pattern-shop drawing, Sheet metal drawing. Limits, Tolerances and Fits- Indication of surface roughness, preparation of process sheets.

Production drawings of Spur, Bevel and Helical gears, swivel bracket, main spindle, crank, revolving centre, jigs and fixtures.

Drawing of Dies. Sheet metal dies. Forging dies, stock strip layouts in sheet metal work, process layout for forge and press operations.

Cutting tool layout. Single point, multi point cutting tools for conventional and CNC machine tools.

Text Book:

1. A Text Book on Production Drawing by K.L.Narayana, P.Kannaiah and K.Venkata Reddy, New age international.

References:

1. Manufacturing technology Foundry, Forming and Welding by P.N.Rao, Tata McGraw Hill Publishing Company Ltd, New Delhi.
2. Production Technologies, HMT.

MEC 316 - ELECTIVE - I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

(A) REFRIGERATION AND AIR CONDITIONING

Course Objectives:

- To acquaint the student with different types of refrigeration systems available commercially, their working and necessity.
- To give the necessary inputs to differentiate between ideal and actual refrigeration cycles and analyze the effect of various parameters on the performance of the refrigeration system.
- To make the student have firm grasp of this interesting subject so that any real time engineering problem encountered can be solved with ease.

Course Outcomes:

The student will:

CO-1	Possess the knowledge on the applications of refrigeration and different t refrigeration systems and their relative advantages and disadvantages.
CO-2	Represent refrigeration cycles on T-S and P-h plots and analyze the influence of various parameters on the system.
CO-3	Select a proper refrigeration system for a given application and evaluate its performance.
CO-4	Have a thorough understanding on the types of refrigerants, nomenclature and their selection.
CO-5	Become conversant with psychrometric properties like DBT, WBT, DPT, specific and relative humidity etc. and various psychrometric processes.
CO-6	Become familiar with types of air conditioning systems and calculation of air conditioning loads and will be able to choose proper system for a given application.
CO-7	Be able to design an air conditioning or a refrigeration system using non-conventional energy sources, like solar energy or through waste heat recovery.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1		3	3	3		1	1	1
CO2	3	3	3	3		2	2			1		1
CO3	2	3	3	3	1	3	3	2		1	1	1
CO4	1	1	3	2		3	3	2		1	1	1
CO5	2	2	3	3								
CO6	2	3	3	3	1	3	3	2		1	1	1
CO7	3	3	3	3	1	3	3	2	1	1	1	1

Principles of Refrigeration: Refrigeration and II law of thermodynamics- Methods of Refrigeration- Unit of Refrigeration- Applications of Refrigeration. Air cycle Refrigeration: Reversal Carnot cycle- Bell Colman cycle- Selection of Refrigeration systems for air crafts- Boot strap system- Regenerative cycle- Reduced ambient type- Comparisons of different systems.

Vapour Compression Refrigeration: Wet versus Dry compression- Effect of evaporator pressures and temperatures. Simple vapour compression Refrigeration cycle and its analysis. Advantages and disadvantages of vapour compression Refrigeration system over Air compression Refrigeration system- Methods of improving C.O.P.- Multi compression system- Multiple evaporators expansion valves- Flash inter cooler- Defrosting- Hot gas defrosting.

Classification of Refrigerants: Nomenclature- Properties- Secondary refrigerants- Selection of refrigerants- **Condensers-** Air cooled, Water cooled and evaporative type- Evaporators- Once through, flooded, shell and tube Baudelot cooler- **Expansion devices**- Capillary expansion device, Thermostatic expansion device.

Absorption Refrigeration System: Basic absorption system- Aqua ammonia absorption system- Li-Br absorption refrigeration system- Electrolux refrigeration- C.O.P. of absorption refrigeration system- Comparison of vapour compression and vapour absorption system. Steam jet refrigeration system and analysis- Advantages and limitation- Ejector compression system.

Psychrometry: Psychrometric properties and relations- Psy chart- Psy processes- Human comfort and comfort chart- Effective temperature and factors governing effective temperature. **Air conditioning**: Summer, Winter and year round air conditioning- Different types of Air conditioning load - By pass factor, RSHP, GSHF- Fresh air quantity- Cooling coils and Dehumidity- Air washers.

Text Books:

1. Refrigeration and Air conditioning, by C.P.Arora.
2. Refrigeration and Air conditioning, by P.L.Bellany.

References:

1. Refrigeration and Air conditioning, by Jordan R.C. and Priester G.B.
2. Principles of Refrigeration, by Dossat.
3. Refrigeration and Air-conditioning, by W.P.Stoecky.

(B) ADVANCED FOUNDRY AND WELDING TECHNOLOGY

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objective:

To demonstrate basic principles of metal casting, mould and pattern design, preparation of mould. Learn various types of dye casting processes and their applications. To understand the solidification mechanism of molten metal and phases involved in it. To acquire knowledge about foundry equipment and their applications. To understand advanced welding processes and their applications. To study weld bead geometry, weld defects and nomenclature used in industry.

Course Outcomes:

CO-1	Students will able to learn mould and pattern design.
CO-2	Students will understand solidification mechanism of molten metal
CO-3	Students will learn about various foundry equipment.
CO-4	Students will acquire knowledge about modern welding processes
CO-5	Students will be able to identify weld defects and reasons for the defects.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	3		3	2	1	2		2	
CO2	1	3	2	3		3	2	1	2		2	
CO3	1	3	2			3	2	1	2		2	
CO4	1	3	1			3	2	1	2		2	
CO5	1	3	1			3	2	1	2		2	

Moulding: Development of metal castings- Materials for moulding- Foundry sand control- Different types of cores- Core making processes- Materials for core making- Moulding and core making machines. Recent developments in core mould making- Cold set process- Investment process- Shell moulding- Hot box method- Shaw process. Vacuum moulding- moulding for mass production.

Melting and Solidification: Furnaces used in foundry for melting ferrous and nonferrous metals- principals of operation of cupola and charge calculations. Family of cast irons- Production of malleable and S.G. Irons- Methods of alloying and inoculants and their effects on the structure and properties of cast iron. Principles of Solidification: Nucleation- Crystal growth- Morphology and structure of cast metals and alloys- Pure metals- Single phase alloys and eutectics. Solidification in sand and chill moulds.

Foundry Mechanization: Layout for ferrous and nonferrous foundries- Description of equipment used for mechanization- Sand conditioners- Conveyors- Cranes- Equipment for handling moulds, Cores and molten metal- Knock out of moulds- Fettling equipment.

Special Welding Processes: Resistance welding processes- Spot, Seam, Projection, Flash butt welding - Machine cycle for resistance welding- Parameters in resistance welding- Electrodes for resistance welding – Solid State Welding: Cold welding – Forge welding - Ultrasonic welding Diffusion welding – Radiation welding: Laser Beam Welding, Electron Beam Welding – Automatic welding systems.

Weldability of Metals: Factors influencing weldability of metals- Welding of Cast steels, Carbon steels, Stainless steels and Cast iron. Weldability of Cu and its alloys, Al and its alloys- Ti and its alloys- Mg and its alloys- Temperature changes in welding and their effects on mechanical properties. Absorption of gases by welds and their effects- Residual stresses and distortion- Heat treatment of welded parts.

Welding Joints, Weld Symbols and Joint Design principles: Types of joints – types of welds – Variants of joints and weld types - Welding symbols – principles of weld joint design and evolving of good weld designs.

Text Books:

1. Foundry Technology, by Jain P.L.
2. Welding Engineering and Technology, by R.S. Parmar.

References:

1. Foundry Engineering, by Agarwal.
2. Foundry Engineering, by Taylor F. & Others.
3. Principles of Metal Castings, by Heine & Others.
4. Modern Welding Technology, by H.B. Cary.
5. Welding Technology, by Koenisburger.
6. Welding Metallurgy, S.Kou, 2ndedition, John Wiley and Sons, New York, NY (2003).

(C) WORK STUDY

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Introduction to work study: Scientific management – Productivity - Advantages of work study to management, Supervisors and workers.

Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study. Developing new method - Job survey report writing.

Principles of Motion Economy: Related to human body, work place, equipment.

Work Measurement: Work measurement techniques – Rating - Measuring the job – Allowances - Standard time - Synthetic data - Analytical estimating – PMTS ,Work factor, MTM, Activity sampling, Its applications.

Job Evaluation, Techniques of job evaluation - Merit rating - Incentive plans.

Ergonomics: Basics of Ergonomics**,** Anthropometry.

Text Books:

1. Introduction to Work Study - International Labour Organisation.
2. Elements of Work Study and Ergonomics by Dalela et al, Standard Publications.

References:

1. Motion and Time Study, by Barnes, John Wiely.

(D) POWER PLANT ENGINEERING

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- The course is intended to provide overall view of all types of power plants.
- To provide a clear cut understanding of the working principles of the power plants and the main components.
- The course also provides an insight into the performance related parameters of all power plants.
- It creates a clear cut understanding of the economies of the power plants and the related topics like fixation of tariff rates.

Course Outcomes:

The student will be able to

CO-1	Understand the working of different types of Boilers, mountings and accessories and Boiler performance.
CO-2	Get an exposure on the accessory systems which work in Tandom with IC engines in internal combustion power plants.
CO-3	Differentiate between different arrangements of gas turbine power plants and their relative merits and demerits.
CO-4	Determine the mass flow rate of water from catchment areas taking into account the losses due to perculasion, evaporation and transportation.
CO-5	Gauge the distinction between various kinds of hydraulic power plants and factors considered in selection of site for hydropower plants.
CO-6	Understand the relative advantages of nuclear power plants in comparison with other power plants.
CO-7	Classify the nuclear reactors, understand their working and get an idea on the different components that a nuclear power plant comprises off.
CO-8	Understand the significance of direct energy conversion devices in comparison with conventional ones.
CO-9	Analyse the economies involved in the operation of power plants, and other factors like cost of erection and maintenance of power plants.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	3	3		1	3	1		1	2	1
CO-2	2	1		1			3	2	2	2		2
CO-3		2	1	1		3	3	1	2	2	1	2
CO-4	1	2	1	1	2	1	1		1	2	2	2
CO-5	3	3	2	2	2	3	3	2	1	1	1	1
CO-6	1		1	1				1				1
CO-7	1	1	1	2		1	1		2		1	2
CO-8	2	2		1	2	1	2	1	1	2	1	1
CO-9	2	2		2	2	2	1	2	1	2	1	2

Steam Power Plants: General Layout, Power plant cycles, Fuels-handling, storing, preparation and supply. Various stokers. Draft systems, chimney including calculations. Boilers: Construction and Heating surfaces. Mountings and accessories. High pressure and high duty forced circulation boilers land modern trends in Boiler design. Flue chambers and dampers. Steam piping–fittings–logging. Boiler performance, Flue gas testing and indicators (mechanical, electrical and chemical).

Internal Combustion Power Plants: Types of engines for power generation, Super charging, Exhaust heating fuel tanks and oil supply systems. Air supply for starting, Lubricating oils and systems of lubrication, Modern trends and design in diesel engines, Performance of engines, Care of diesel plants. Gas Turbine and other Propelled Power Plants: Introduction – Gas turbine plant– Classification and comparison of different types of gas turbine power plants – Components and different arrangements of the gas turbine plants – Indian gas turbine power plants–Governing system of gas turbine plant–Marine, Aero and Rocket Propulsion power plants.

Hydro Electric Plants: Hydrology, Hydrometric survey rainfall, Catchment, Reservoir, Run-off flow and fall, Storage and pondage, Losses due to percolation, Evaporation and transpiration. Mass–duration and flood discharge. Frequency studies and gauging. Different types of plants. Selection of site. Low, medium and high head plants and pumped storage plants. General layout of the plant – Head works, Spillways, Canals, Tunnels, Governing, Lubrication, Penstock, Anchorages and relief valves, different types of surge tanks, intakes, Gates and Valves.

Nuclear Power Plants: Classification of reactors, Thermal utilization, Fuels, Fuel moderator and coolant, Control and safety rods, Special properties of structural materials required, Induced radio-activity, Gas cooled reactors, Radiation hazards and shielding, Radio active waste disposal.

Direct Energy Conversion: Solar Energy–Introduction, Solar radiation, Solar collectors, Energy storage. Wind Energy–Wind mills. Thermo Electric–MHD and other non conventional energy sources. Power Plant Economics: Capacity factor, Load actor, Diversity factor, Peak load consideration, Factors governing capacity of plants. Cost of power plant, Cost of erection. Operating & maintenance expenses, Cost of production, distribution of power & determination of rates.

Text Books:

1. Power Station Engineering and Economy by Benhaedt G.A.Skrotzki, William A. Vopat, MGH Book , Inc.
2. Heat Engineering, I.T. Shvets et al, MIR Pub Moscow.
3. A Course in Power Plant Engineering,S.C.Arora&S.Domdundwar.

References:

1. Solar Power Engineering by B.S. Magal, TMGHPub Co..
2. Solar Energy by S.P. Sukhatme, T MGH pub. Co.
3. Modern Power Plant Engineering by Joel Weisman, Roy Eckart, PHI.
4. Atextbook of Power Plant Engineering by P.C. Sharma,S.K. Kataria&Sons, ND.
5. Fundamentals of Nuclear Power Engineering by D.K. Singhai,Khanna Pub.

(E) FINITE ELEMENT ANALYSIS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To introduce students to the basics of theory of elasticity.
- To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics
- To teach students the characteristics of various elements in structural analysis and selection of suitable elements for the problems being solved.
- To make the students derive finite element equations for different elements.

Course Outcomes:

Student will be able to:

CO-1	Apply the knowledge of Mathematics and Engineering to solve problems in structural mechanics by approximate methods.
CO-2	Derive the finite element equations for different elements.
CO-3	Solve the one dimensional and two dimensional problems in solid mechanics using FEM.
CO-4	Derive the shape functions for higher order isoparametric elements.
CO-5	Do the modal analysis of bars and beams

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1			1		1	1	
CO2	1	2		2	1			1		1		1
CO3	3	3	2	2	1			1		1	1	
CO4	1	2		2	1			1		1		1
CO5	3	2	2	2	1			1		1	1	

Fundamental Concepts: Introduction, Historical background, Outline of presentation, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle. Galerkin's method, Saint Venant's principle.

One-dimensional Problems: Introduction, Finite element modeling, Coordinates and Shape functions. The potential energy approach. The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects. Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, In plane and Bending, problem modeling and boundary conditions.
Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.
Two-dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical integration, Higher-order elements. Beams and Frames: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

Text Book:

1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only).

References:

1. Introduction to Finite Element Method, by S.S.Rao
2. Finite Element Method, by O.C. Zienkiewicz.
3. Concepts and Applications of Finite Element Analysis, by Robert D. Cook.
4. Introduction to Finite Element Method, by J.N.Reddy.

(F) COMPUTER GRAPHICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

To make the student Understand

- This course able to discuss hardware system architecture for computer graphics and Basics of colour raster scan display devices and draw lines and circles on it.
- Know and be able to design and implement model and viewing transformations.
- To introduce the concept of rendering and shading of objects.
- To explain the higher order curves like B-spline and Bezier curves.
- Be able to discuss the application of computer graphics concepts in the development of visualization, and CAD/CAM applications.

Course Outcomes:

The students will be able to:

Upon successful completion of this course, the students will be able to learn

CO-1	Learn the Principles and commonly used paradigms and techniques of computer graphics.
CO-2	Draw lines and circles on colour raster scan display devices
CO-3	Develop a facility with the relevant mathematics of computer graphics
CO-4	Fill Polygons and clip lines and polygons against a window, transform, render and shade objects
CO-5	Eliminate Hidden lines and surfaces using algorithms

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		1		3							2
CO2	1	1			3							
CO3	3	1	1	1								
CO4	1	1	1	1	2							
CO5	1	1	1	1	2							

Geometry and line generation: Line segments, Pixels and frame buffers, Bresenham's algorithms: line, circle, ellipse generation.

Graphics primitives: Primitive operations, The display-file interpreter, Display-file structure, Display-file algorithms.

Polygons: Polygons representation, An inside test, Filling polygons, Filling with a pattern.

Transformations: Scaling transformations, Reflection and zooming, Rotation, Homogeneous coordinates and translation, Rotation about an arbitrary point.

Segments: The segment table, Segment creation, Closing a segment, Deleting a segment.

Windowing and clipping: The viewing transformation, Clipping, The clipping of polygons, Generalized clipping.

Three dimensions: 3D geometry, 3D primitives, 3D transformations, Parallel projection, Perspective projection, Isometric projections, Viewing parameters, Special projections.
Hidden surfaces and lines: Back-face removal, Back-face algorithms, The Painter's algorithm, Warnock's algorithm, Franklin algorithm, Hidden-line methods.
Light, color and shading: Point-source illumination, Shading algorithms, Shadows, Color models.
Curves and fractals: Curve generation, Interpolation, B splines, Curved surface patches, Bezier curves, Fractals, Fractal lines, Fractal surfaces.

References:

1. Computer Graphics - A Programming Approach by Steven Harrington, McGraw-Hill International Edition, 1987.
2. Schaum's Outline of Theory and Problems of Computer Graphics by Roy A. Plastock and Gordon Kalley, McGraw-Hill Companies, Inc., 1986.
3. Mathematical Elements for Computer Graphics by David F. Rogers adn Adams.

MEC 317 - MECHANICAL ENGINEERING LAB-II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50
Examination (Practical): 3hrs. Credits: 2

Course Objectives:

- To impart training to the student on the basics of internal combustion engines
- Construction, operation and performance assessment.
- To apply the theoretical concepts learned in the classroom on the thermodynamic
- Devices like engines, compressors etc. through conducting different tests.
- To study various mechanisms and apply the kinematic principles to them.

Course Outcomes:

The student will be able to

CO-1	Get conversant with different types of engines-their anatomy, working and general Problems encountered in their functioning.
CO-2	Perform various kinds of tests on engines which would give a thorough idea on the Methodology followed in evaluating the performance of I.C.Engines.
CO-3	Make a comparison between graphical and analytical methods adopted in the Analysis of some simple mechanisms.
CO-4	Understand gyroscopic principle and its applications.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	1	3		1	2		3	2	2	2
CO-2	2	2	1	3	2	1	2	1	2	2	1	1
CO-3	3	1	3	1					1			1
CO-4	3	1	1	2	1						1	1

1. Load test and smoke test on I.C. Engines.
2. Morse test on multi-cylinder engine.
3. Heat balance sheet on I.C. Engines.
4. Study of multi-cylinder engines and determination of its firing order.
5. Calculations of efficiencies of the given air compressor.
6. Determination of pressure distribution around the given (1) cylinder and (2) airfoil specimens kept in a uniform flow wind-tunnel.
7. Study of automobile mechanisms.
8. Verification of laws of balancing.
9. a) Determination of ratios of angular speeds of shafts connected by Hooke's joint.
   b) Determination of the ratio of times and ram velocities of Withworth quick return motion mechanism.

10. To draw curves of slider displacement and crank angle and linear velocities w.r.t. time for a slider crank mechanism and compare with theoretical values.
11. To determine the relation of gyroscopic couple and compare with the theoretical values.
12. To draw the crank angle vs. pressure diagram for an I.C. engine using pressure transducer and cathode ray oscilloscope.

MEC 318 - MANUFACTURING TECHNOLOGY LAB – II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50
Examination (Practical): 3hrs. Credits: 2

Course Objective:

To measure cutting forces in machining processes like during, milling and milling. Able to study the chip formation and surface roughness during machining and carry out various tests on moulding sand.

Course Outcomes:

CO-1	Students will have hands on experience in operating the lathe, drilling and milling machines.
CO-2	Students will be able to understand the factors effecting the surface roughness and forces acting on various types of cutting tools.
CO-3	Students will be able to measure torque and trust force in drilling and cutting forces in milling and turning process.
CO-4	Students will be able to calculate properties of moulding sand.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	3	3	2	3		2	3		3	
CO2		3	3	3	2	3		2	3		3	
CO3		3	3	3	2	3		2	3		3	
CO4		3	3	3	2	2		2	3		3	

1. Experiments on Lathe to establish the following curves
    a) Depth of cut Vs Cutting force.
    b) Feed Vs Cutting force.
    c) Cutting speed Vs Cutting force.
2. Grinding of single point cutting tool as per given specifications (to check the tool angles).
3. Study of chip formations on shaping machine (with lead sample).
4. Torque measurement on drilling/milling machine.
5. Effect of speed and feed on surface roughness.
6. Measurement of cutting tool temperature in turning.
7. Sieve analysis to evaluate G.F.No.
8. Moisture and clay content test.
9. Green compression and shear test.
10. Shatter Index & Hardness Testing

MEC 319 – SOFT SKILLS LAB.

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr Credits: 1

(Common for all Branches of Engineering)

Objectives Of The Course

- To prepare the students to function effectively in teams that would help them building a successful career.
- To make the students aware of the importance of verbal and non-verbal communication skills
- To enable the students to make successful presentations
- To make students understand the purpose of group discussions in their professional life and expose the students to the different positive roles in group discussions
- To make the students identify their strengths and pinpoint the areas where they should work on to enhance their time management skills
- To help the students carry out self-analysis, self-motivation and build up confidence to set appropriate goals in life
- To equip the students with all the skills for Campus recruitment

Course Outcomes

At the end of the course students should be able to:

CO-1	Work effectively in teams and emerge as assertive leaders.
CO-2	Practice positive postures and gestures and communicate with others effectively.
CO-3	Present a topic confidently using positive body language and appropriate material aids.
CO-4	Participate in group discussions and give a proper direction to the discussion by playing a few positive roles.
CO-5	identify successfully time wasters and barriers and could plan his schedules profitably
CO-6	Set a few short term and long term goals for himself which would give him direction for his successful career.
CO-7	Face the different stages of campus recruitment successfully.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1									3			
CO-2										3		
CO-3										3		
CO-4									3	3		
CO-5											3	
CO-6												3
CO-7										3		

Communication:
Importance of communication
Non verbal communication
Personal appearance
Posture
Gestures
Facial expressions
Eye contact
Space distancing

Goal setting:
Immediate, short term, long term,
Smart goals, strategies to achieve goals

Time management:
Types of time
Identifying time wasters
Time management skills

Leadership and team management:
Qualities of a good leader
Leadership styles
Decision making
Problem solving
Negotiation skills

Group discussions:
Purpose (Intellectual ability, creativity, approach to a problem, solving, tolerance, qualities of a leader)
Group behavior, Analyzing performance

Job interviews:
Identifying job openings
Preparing resumes & CV
Covering letter
Interview (Opening, body-answer Q, close-ask Q),
Types of questions

Reference books:

1. 'Effective Technical Communications' by Rizvi M. Ashraf, McGraw–Hill Publication
2. 'Developing Communication Skills' by Mohan Krishna & Meera Banerji, Macmillan
3. 'Creative English for Communication' by N.Krishnaswami & T.Sriraman, Macmillan
4. 'Professional Communication Skills' by Jain Alok, Pravin S.R. Bhatia & A.M. Sheikh, S.Chand & Co.

B.E. (MECH.) - III/IV
(II-SEMESTER)
MEC 321 - FLUID MECHANICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th. Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits: 4

Course Objectives:

- To acquaint the student with the fundamental principles of fluid mechanics and their significance and also to enable them to analyse any practical problem involving fluids and find a solution to it.
- To make the student conversant with the devices used for measuring pressure, determining hydro static forces on surfaces, classification of fluid flows and their analysis.
- To introduce the concept of boundary layer and its effect on the flow over submerged bodies.

Course Outcomes:
The student will be able to:

CO-1	Understand and apply the basic concepts of physical parameters like absolute viscosity, kinematic viscosity, surface tension, capillarity etc. in practical fluid flow problems.
CO-2	Have a thorough knowledge of different types of fluid flows and analyze the forces acting on a fluid in motion.
CO-3	Derive the equation of motion –continuity equation, momentum equation and apply them to practical problems like flow through pipes.
CO-4	Get a overall view of boundary layer concepts, flow separation and methods of controlling it.
CO-5	Utilise a strong mathematical tool called dimensional analysis to form dimensionless groups of the parameters effecting any physical phenenonenon .Further the student will be able to use dimensionless numbers like Reynolds number, Weber number etc.. in model analysis
CO-6	Differentiate between compressible and in compressible fluid flows and get an idea on stagnation properties which are relevant to solving compressible fluid flow problems

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

Outcomes												
CO1	2	2		1								1
CO2	3	3	3	2	1	1	1				1	1
CO3	3	3	3	2	1	1	1				1	1
CO4	3	3	3	3	1		1			1	1	2
CO5	3	3	3	3	1		2		1		1	2
CO6	3	3	3	3	1		1				1	2

Properties of fluids- Introduction-Viscosity- Pressure and its measurement , Absolute, Gauge, Atmospheric and Vacuum pressure – Manometers, Simple manometers, Differential manometers. Hydrostatic forces on surfaces- Total Pressure and Pressure Centre- Vertical, Horizontal, inclined and Curved plane surfaces submerged in liquid- Buoyancy and Floatation.

Fluid Kinematics & Fluid Dynamics: Types of fluid flow- Continuity equation- Velocity potential function and Stream Function- Types of Motion, Linear Translation, Linear deformation,Angular deformation, Rotation, Vorticity and circulation-Vortex flow, forced and Free Vortex – Equation of Motion- Euler's equation - Bernoulli's equation and its applications- Venturimeter, Orifice Meter, Pitot tube-Momentum Equation-Momentum of momentum Equation- Free Liquid Jet- Flow net analysis.

Viscous Flow: Couette flow- Plane Couette flow, Favourable pressure gradient and adverse pressure gradient-Power absorbed in Viscous Flow- Flow through pipes- Hagen Poiseulle flow- Fannigs friction factor- Darcy's Weisbach friction factor- Loss of head due to friction in pipes, Minor Losses and Major losses - Flow through branched pipes- Power transmission through pipes-Two dimensional viscous flow: Navier -Stokes equations and solutions- Order of magnitude analysis- Boundary layer equations.

Laminar Boundary Layer: Definition**-** Laminar Boundary Layer- **Turbulent Boundary Layer** - Laminar Sub layer- Boundary Layer thickness-Displacement thickness, Momentum thickness and Energy thickness-Momentum integral equation- Flow over a flat plate.

Turbulent Boundary Layer: Laminar- Turbulent transition- Momentum equations and Renold's stresses- Fully developed turbulent flow through a pipe- Turbulent boundary layer on a flat plate-Laminar sub-layer- Boundary layer separation and control.

Dimensional and Modeling Analysis: Fundamental and derived dimensions- Dimensionless groups-Rayleigh method- Buckingham π-theorem- Model Analysis - Types of similarity- Geometric, Kinematic and Dynamic similarities- Dimensionless numbers- Modal Laws- Hydraulic diameter.

Compressible Fluid Flow: Thermodynamic relations- Continuity, Momentum and Energy equations-Velocity of sound in a compressible fluid- Mach number and its significance- Limits of incompressibility- Pressure field due to a moving source of disturbance- Propagation of pressure waves in a compressible fluids- Stagnation properties- Stagnation pressure, Temperature and density-Area velocity relationship for compressible flow- Flow of compressible fluid through nozzles-Condition for maximum discharge through nozzles- Variation of mass flow with pressure ratio-Compressible flow through a venturimeter- Pitot static tube in a compressible flow.

Text Book:

1. Fluid Mechanics and Hydraulic Machines, by R. K. Bansal, Laxmi publications.
2. Fluid Mechanics, by A.K. Mohanty, Prentice Hall of India Pvt.Ltd.

References:

1. Fluid Mechanics and Fluid Power Engineering by Dr. D.S. Kumar, S.K. Kataria &Sons.
2. Foundations of Fluid Mechanics, by Yuan, Prentice Hall of India.
3. Fluid Mechanics and its Applications, by S. K.Gupta and A.K.Gupta, Tata McGraw Hill, New Delhi.
4. Fluid Mechanics and Hydraulic Machines by R. K. Rajput, S.Chand & Co.
5. Fluid Mechanics by Kothandaraman and Rudramoorthy.

MEC 322 - DESIGN OF MACHINE ELEMENTS – I

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th. Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course Objectives:

To make the students

- To be competent in the field of design to formulate a new plan or modify the existing design
- Develop an ability to apply knowledge of mathematics, science, and engineering to Real time Problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To identify the type of materials used to design a system and predict the failure of Mechanical component
- To develop an ability to identify, formulate, and solve engineering problems.
- To develop an object or component subjected to static and fluctuating loads.

Course Outcomes:

Students will be able to

CO-1	Design a competitive product by following all the design considerations
CO-2	Analyze the type of failure and determine the geometrical dimensions of the component based on the various Criterion of the design
CO-3	Analyze the various types of stresses on mechanical components subjected to both static and dynamic loads.
CO-4	Design threaded and welded joints, subjected to Eccentric & fluctuating loads.
CO-5	Design shafts, keys and couplings and spring subjected to static and dynamic loads.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3	2	3						1	1
CO2	3	2	1	2	2						1	1
CO3	3	2		1	2						1	1
CO4	3	2	3	1							1	1
CO5	3	1	3	1	2						1	1

Introduction to Mechanical engineering design: traditional design methods, different design models, Problem formulation, Design considerations, engineering materials and processes and their selection, BIS designation of steels, Mechanical properties, Load determination, manufacturing considerations in design.

Design against static loads: Modes of failure, Factory of safety, Axial, bending and torsional stresses, Stress concentration factors. Static failure theories.

Fluctuations and fatigue stresses, Soderberg, Goodman and modified Goodman diagrams, fatigue failure, design consideration in fatigue

Threaded and welded joints: forms of threads, basic types of screw fastenings, ISO metric screw threads, eccentrically loaded bolted joints, Torque requirement for bolt tightening, Fluctuations loads on bolted joints, fasteners, Joints with combined stresses. Power screws, Force analysis. Collar friction, Differential and compound screws design. Types and strength of weld joints subjected to bending and fluctuating loads, cotter and knuckle joints, welded joints, different types welded joints and their design aspects, welding inspection

Shafts, keys and couplings: shafts design on strength basis, torsional rigidity basis, Design of hollow shafts, flexible shafts, ASME codes for shafts, Keys and cotter design, Flat, square keys, Splines, Rigid and flange couplings, Flexible couplings

Spring Design: classification and spring materials, Spring end formation, Design of helical compression springs, helical extension springs, torsion springs, laminated springs, Protective coatings, Equalized stress in spring leaves. Multi - leaf springs. Surge in springs, Nipping and shot peening.

Text Books:

1. Design of Machine Elements by V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi

References:

1. Machine Design by Jain, Khanna Publications.
2. Machine Design by Pandya and Shaw, Charotar publications
3. Machine design , an integrated approach by R.L.Norton, 2nd edition, Pearson Education

MEC 323 - MANUFACTURING TECHNOLOGY – III

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Sess. : 30 Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course Objective:

To demonstrate basic principles of NC, CNC, DNC and FMS. Able to learn how data is transformed from digital to analytical format. To learn G and N codes to write programming for CNC machining. To understand representation of tolerances and limits of machined components and learn about various metrology instruments. To know various acceptance tests used for various machines.

Course Outcomes:

CO-1	Students will able to understand the basic principles of CNC.
CO-2	Students will able to write part programming for CNC.
CO-3	Students will able to acquire knowledge about limits and fits and their applications.
CO-4	Students will learn about tool room metrology and how to use various measuring instruments.
CO-5	Students will able to understand about various acceptance tests carried out on machine tools.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		2	2			1	2		1	
CO2	1	3		3	3	1		1	2		1	
CO3	3	2	1	3	2			1	2		1	
CO4	2		3	3	3	3		1	2		1	
CO5		3	2	3	3	1		1	2			

Automatic screw lathes, Multi spindle automatic lathes, Turret lathes, Numerical control, NC operation, Coordinate system, Data input devices, Data storage, Programme editing, Machining centres, Turning centres, Vertical turning centres, Milling centres, Advantages of NC, Computers & NC, CNC, DNC, CAD/CAM, Computer graphics, Computer aided manufacturing, Robots, Flexibility in manufacture, Automatic sensing for FMS, Areas affected by FMS, Steps toward automatic factory.

CNC part programming: Designation of co-ordinate axes for CNC machines, Functions of machine control units, Tape format, Manual part programming and computer assisted part programming (using APT language). Exercises involving simple contours and positioning.

ISO system of limits, Fits and Tolerances, Interchangeability, Plain limit gauges, Measurement of screw threads, major diameters, Minor diameters and effective diameter, Pitch, Limit gauges for

internal and external threads, Measurement of spur gears, pitch, profile, lead, backlash, tooth thickness.

Tool maker's microscope, Straightness measurement, Slip gauges, Twisted strip mechanical comparator, Optical lever comparator, Optical projector, Electric comparator, Pneumatic comparator, Squareness testing, Optical bevel protractor, Sine bar, Angle gauges, Precision level, Autocollimeter, Angle dekkor, Optical dividing heads and rotary tables, Flatness measurement, Roundness measurement. Co-ordinate measuring machines.

Surface texture: Parameters, sampling length, Specification, Stylus instruments for surface roughness measurement. Acceptance tests on machine tools: Lathe, Milling machine, Radial drill, Laser equipment.

Text Books:

1. Process & Materials of Manufacture, R.A.Lindberg, 4th edition, Prentice-Hall of India, New Delhi.
2. A Text Book of Engineering Metrology, I.C.Gupta, Dhanpat Rai & Sons, Delhi.
3. CNC and Computer Aided Manufacturing, T.K.Kundra, P.N.Rao & N.K.Tewari, Tata McGraw-Hill Publishing Company Ltd, Delhi.

References:

1. A.S.T.M.E., Hand book of Industrial Metrology, Prentice-Hall of India, New Delhi.
1. A.S.T.M.E., Hand book of Manufacturing Engineering.
2. Manufacturing Processes & Materials for Engineers, L.E.Doyle & others, Prentice-Hall of India, New Delhi.
3. Manufacturing Technology by Adithan, New age international.

MEC 324 - INDUSTRIAL ENGINEERING AND MANAGEMENT

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course objectives:

- To acquaint the student with fundamental concepts of industrial management, to discuss the functions of personal management; industrial relations; production systems; production planning and control;
- To introduce principles of plant layout; material handling; plant maintenance; concept of productivity; materials management; concept of method study and work study measurement; concepts of Quality control.

Course outcomes:

CO-1	Students will be able to understand the principles of Industrial Engineering.
CO-2	The student will be able to learn the concepts of time study, work study which are commonly used in any Industry
C0-3	The student will be able to learn the concepts of material management
CO-4	The student will be able to learn the concepts of production planning and control
CO-5	The student will be able to learn the concepts of quality control

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	1		3		2			3	3		3	
CO-2	1		3		2			3	3		3	
CO-3	2		3		2			3	3		3	
CO-4	1		2		1			3	3		3	
CO-5	1		3		1			3	3		3	

Concepts of Industrial Management: Principles of management- Growth of management thought, Functions of management, Principles of organization, Types of organization and committees.

Introduction to personnel management- Functions, Motivation, Theories of motivation, Hawthrone studies, Discipline in industry, Promotion, Transfer, lay off and discharge, Labour turnover.

Industrial relations- Trade unions, Industrial disputes, Strikes, Lock-out, Picketing, Gherao, Settlement of industrial disputes, Collective bargaining, Industrial dispute act 1947 and factories act 1948.

Production Planning and Control: Types of productions, Production cycle, Product design and development, Process planning, Forecasting, Loading, Scheduling, Dispatching, Routing, Progress, Control, Simple problems.

Plant Layout: Economics of plant location, Rural Vs Suburban sites, Types of layouts, Types of building, Travel chart technique, Assembly line balancing simple problems.

Materials Handling- Principles, Concept of unit load, Containerization, Pelletization, Selection of material handling equipment, Applications of belt conveyors, Cranes, Forklift trucks in industry.

Plant Maintenance: Objectives and types.

Work Study: Concept of productivity, Method Study **-** Basic steps in method study, Process charts, Diagrams, Models and Templates, Principles of motion economy, Micro motion study, Therbligs,

SIMO chart. Work Measurement - Stop watch procedure of time study, Performance rating, allowances, Work sampling, Simple problems.

Materials Management: Introduction, Purchasing, Objectives of purchasing department, Buying techniques, Purchase procedure, Stores and material control, Receipt and issue of materials, Store records. Inventory Control, EOQ model(Simple problems).

Quality Control - Control charts of variables and attributes (Use of formulae only). Single and Double sampling plans.

Text Book:

1. Industrial Engineering Management, by Dr. O. P .Khanna.

References:

1. Principles of Management by Koontz & Donnel.
2. Production and Operations Management by Everette Adam & Ronald Ebert.
3. Operations Management by John McClain & Joseph Thames.
4. Industrial Engineering and Production Management by Telsay, S. Chand & Co.

MEC 325 - ENGINEERING THERMODYNAMICS-III

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To impart the student the fundamentals of I.C Engines
- To generate an interest and understanding in evaluating the performance of thermodynamic machinery like engines, compressors, gas turbines and propulsion systems.
- To focus the attention of students on an intricate phenomena like combustion in engines and to create an keen interest in the student for further research.

Course Outcomes:

The student will able to

CO-1	Have a complete grasp on the construction and working principles of I.C Engines.
CO-2	To have a clear understanding on the differences between air standard cycle, Fuel air cycles and actual cycles.
CO-3	Have a thorough grip on the performance analysis of I.C engines.
CO-4	Understand the factors that differentiate between normal and abnormal combustion phenomena in both S.I and C.I engines.
CO-5	Rate the fuels and also understand the distinction in the properties of S.I C.I engines fuels.
CO-6	Distinguish between positive displacement and roto-dynamic compressors.
CO-7	Understand the construction and working of displacement and steady flow compressors.
CO-8	Understand the effect of regeneration, inter-cooling and reheating on the performance of gas turbine plant.
CO-9	Analyze the distinctive features of Turbo jet, Turbo prop, Turbo-fan, Ram jet and pulse jet engines and their performance.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	2	1			1			1	1	1
CO-2	2	2	2	3	1		1			1	1	1
CO-3	3	3	3	2	2	1	1	1		1	1	1
CO-4	3	3	3	2	3	1	1		1	1	1	1

CO-5	2	2	3	2	2	1	1			1	1	
CO-6	3	3	3	2	2	1	1				1	
CO-7	2	2	3	2	2					1		
CO-8	3	3	3	3	2	1	1				1	1
CO-9	3	3	3	2	2	2	1	1		1	1	1

I.C. engines: classification-comparison of two stroke and four stroke engines- comparison of S.I. and C.I. engines**-**Air cycles-Otto, Diesel, Dual, Stirling, Ericson and Atkinson cycles and their analysis-Valve timing and port timing diagrams- Efficiencies- air standard efficiency,indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, volumetric efficiency and relative efficiency-Testing and performances of I.C. engines-Basic principles of carburetion and fuel injection.
Combustion in I.C. Engines: S.I. engines- Normal combustion and abnormal combustion-Importance of flame speed and effect of engine variables-types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additions- Combustion chamber requirements and Types of combustion chamber- Design principles of combustion chambers-C.I. engines- Stages of combustion- Delay period and its importance- effect of engine variables, diesel knock, suction compression and combustion induced turbulence, open and divided combustion chambers.
Reciprocating and Rotary Compressors: Reciprocating compressors-effect of clearance in compressors, volumetric efficiency-single stage and multi stage compressors-effect of inter cooling in multi stage compressors-Vane type blower-centrifugal compressor- Adiabatic efficiency- Diffuser-Axial flow compressors- Velocity diagrams, degree of reaction, performance characteristics.
Gas Turbines: Simple gas turbine plant- Ideal cycle, closed cycle and open cycle for gas turbines-Efficiency, work ratio and optimum pressure ratio for simple gas turbine cycle- Parameters of performance- Actual cycle, regeneration, Inter-cooling and reheating, closed and semi-closed cycle-Jet propulsion and Rockets.
Nuclear power plants: Classification of reactors-Thermal utilization-Fuels, Fuel moderator and coolant, Control and safety rods, Special properties of structural materials required, Induced radio-activity-Gas cooled reactors, Radiation hazards and shielding-Radio active waste disposal.
Direct Energy Conversions and non conventional energy sources: Solar Energy- Introduction, Solar radiation, Solar collectors, Energy storage-Wind Energy- Wind mills-Thermo Electric- MHD.

Text Books:
1. A Treatise on Heat Engineering by Vasandhani and Kumar.
2. Applied Thermodynamics-II by R. Yadav.

References:
1. Thermal Engineering, by R.K.Rajput.
2. I.C. Engines, by Mathur and Nehata.
3. Gas Turbines, by Cohen and Rogers.
4. Fluid Flow Machines, by M.S. Govinda Rao, Tata McGraw Hill publishing company Ltd.
5. I.C. Engines by V. Ganesan.
6. Power Plant Engineering, P.K.Nag
7. Non Conventional Energy Sources, G.D.Rai
8. Internal Combustion Engines by R.K. Mohanty, Standard Book House.

MEC 326 - ELECTIVE – II
(A) GAS TURBINES AND JET PROPULSIONS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course Objectives:

- To provide the student with the principles of compressible fluid flow.
- To create an understanding of the working principles of steady flow compressor and the factors effecting their performance.
- The course intends to provide an insight into the combustion mechanism, types of combustion chambers and their requirements.
- A thorough understanding of propulsion system and their working is provided in this course. Further the effects of the working parameters on the efficiency system is also studied.

Course Outcomes:

The student will be able to

CO-1	Select the type of compressor for any application and evaluate its performance.
CO-2	Have a thorough knowledge on combustion phenomena of a steady flow combustion chambers.
CO-3	Understand the working principles of both impulse & reaction gas turbines.
CO-4	Choose & design a regenerator for any application.
CO-5	Apply the principles of mechanics and thermodynamics in determination of thrust, propulsive efficiency, thermal efficiency and overall efficiency of a propulsive system.
CO-6	Distinguish between the different types of jet engines and their relative merits and demerits and their applications.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1	2	2	1			1					
CO-2	1	3	3	2	1	1	3	1	1	1		1
CO-3	2	1	1	1	2	1	1	1		1		
CO-4	3	2	3	3	3	1	1				2	1
CO-5	3	3	2	2	1	1						1
CO-6	3	3	3	3							2	1

Introduction: Development- Competition- Competition Rules- Present and Future Status- Gas Turbine Problems.

The Fundamentals of Gas Turbines: Introduction- Conservation of Mass Continuity Equation- Conservation of Energy (First Law of Thermodynamics)- Momentum Equation- Sonic Velocity, Mach Number and Mach Waves-Stagnation Temperature, Pressure and Enthalpy- Isentropic Flow Through a Passage of varying cross sectional Area- Normal Shock- Equations for Normal Shock – Governing Equations- Impossibility of a Refraction shock- Strength of Shock wave- Shocks in a converging, Diverging Nozzle.

Ideal Power Plant Cycles: Introduction- Carnot Cycle- Stirling Cycle with Regenerator-Ericsson Cycle- The Joule Air Cycle- Brayton Cycle- Brayton Cycle with Regeneration- Complex Cycle- The Close Cycle- Operating Media other than Air.

Performance of a Actual Gas Turbine Cycles: Efficiency of the compressor and Turbine- Pressure or Flow Losses- Heat Exchanger Effectiveness- Effect of varying mass Flow-Loss due to incomplete combustion- Mechanical Losses- Effect of Variable Specific Heat- Calculation of Fuel consumption and cycle Efficiency- Polytrophic Efficiency- Performance of Actual Cycles.

Centrifugal Compressors: Introduction-Components- Method of Operation- Theory of Operation- Ideal Energy Transfer- Actual Energy Transfer-Slip- Analytical Methods of Determining σ- Power Input Factor- Pressure Coefficient- Compressors Efficiency- Inlet or Inducer Section, When Entrance is Axial, Sizing of Inducer Section, Prewhirl- Impeller Passage, The Effect of Impeller Blade Shape on Performance, The Impeller Channel- The Compressor Diffuser- Losses in Centrifugal Compressors- Compressor Characteristics- Surging and Choking.

Axial Flow Compressors: Introduction- Description- Principles of Operation- Performance Analysis- Momentum or Filament Analysis, Special Velocity Diagrams, Symmetric Stage, Non-Symmetric Axial -in flow, Non-Symmetric Axial- outflow- Actual Energy Transfer- Air Foil Analysis, One Dimensional Ideal Incompressible Flow, Two Dimensional flow With Friction- Blading Efficiency, Losses in terms of Air Angles and Drag Co efficient- Coefficient of Performance, Flow Coefficient (Φ), Pressure Coefficient (ψ_p),Work Coefficient(Ω)- Blade Loading- Cascade Characteristics-Blade angles- Reynolds and Mach Number Effects- Three Dimensional flow Analysis, Radial Equilibrium Theory, Free Vertex Blades, Constant Reaction Blades, Forced Vortex of Solid Rotation Blades, The General Design -Three Dimensional Blades Losses- Compressor Stall and Surge - Overall Performance- Compressor Characteristics.

Combustion Systems: Introduction- Combustion Mechanism- Pressure Losses- Combustion Intensity- Combustion Efficiency- Requirements of the Combustion chamber- Shape of the Combustion chamber- Stabilizing or Primary Zone- Dilution and Mixing- Combustion- Chamber Arrangements- Fuel Injection System.

Axial Flow Gas Turbines: Introduction- Description- Turbine and Nozzle efficiencies- Degree of Reaction, Ideal Impulse Turbine, Impulse Turbine with Loss, Blades Speed Ratio, Velocity Ratio and Torque, Velocity Compound Turbine (Curtits Stage)- The Reaction Turbine- Three Dimensional Flow Analysis, The Free Vortex Blades

Regenerator- Introduction--Types of Regenerators- Heat Transfer in Direct type Exchanger, Exchanger Heat Transfer Effectiveness, Number of Exchanger Heat Transfer Units- Effect of Flow Arrangement, Effect of Cmin/Cmax<1for a Regenerator- Rotary heat Exchangers.

Jet Propulsions: Introduction-The Ramjet Engine-The Pulse-jet Engine- The Turbo-jet Engine- Thrust Equation—Specific Thrust of the Turbo Jet Engine- Efficiencies- Inlet Diffuser or Ram Efficiency- thermal Efficiency of the TurboJet Engine- Propulsive Efficiency- Overall Efficiency of a Propulsive system- Effect of Forward Speed- Effect of Attitude- Overall Turbojet Process- Thrust augmentation- The After burn-Injection of Water, Alcohol Mixtures- Bleed- Burn Cycles.

Text Books:

1. Gas Turbines and Propulsive Systems by P.R. Khajuria and S.P. Dubey, Dhanpat Rai & Sons

Reference Books:

1. Gas Dynamics and Jet Propulsion By Murugaperumal, SCITECH Publications.

(B) AUTOMOBILE ENGINEERING

(C)

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course Objectives:

- To provide an introduction to the basic principles of an automobile and functioning of its components.
- To strengthen the student's knowledge of various automobile systems like transmission, suspension, control, etc.
- To make students understand operational features of different types of engines used in automobiles.
- To expose students to the pollution norms and to make them aware of environment friendly vehicles.
- To impart basic concepts related to electrical and electronic systems used in automobiles.

Course Outcomes:

The student will be able to:

CO-1	Students will have clear idea about the principles of automobile and its functioning.
CO-2	Students can explainthe significance of various systems in automobile.
CO-3	Students will have the ability to explain the operational features of different engine types.
CO-4	Students will be able to reach latest advancements by building upon the fundamentals learnt in this course.
CO-5	Students will learn the principles related to electrical and electronic systems of automobile.
CO-6	Students will comprehend the importance of eco-friendly engineering.

Mapping of Course Outcomes with Programme Outcomes.

Strong -3, Medium -2, Low -1

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	3	2	1	2	1	2	2		2
CO-2	2	3	2	1	2		1	1	3	2	1	2
CO-3	2	3	3	3	2	1	2	1	2	2	1	3
CO-4	2	2	2	2	2	2	3	2	1	3	2	3
CO-5	2		2	1	1	1	2	1	2	1	2	2
CO-6	1	1	3	2	1	3	2	3	2	1		3

Introduction: Definition of automobile, Automobile Layout, Chassis and Transmission: Introduction to Drive Train: Clutch, Gearbox, Hook's Joint, Propeller /Drive Shaft, Slip Joint, Final Drive and

Differential, Front and Rear Axles, Wheels and Tires, Control systems: Introduction to Steering, and Brakes. Electrical system: Introduction to Starting System, Ignition, dynamo/alternator, cut-out and wiring. Automobile Body: Parts and Stream lining, Automobile types: Front, Rear and Four wheel drive and Automotive materials.

Engine (Power Plant): Multi cylinder engine parts, Classification: 'In-line' and 'V' type, Multi-Valve Engines, VCR Engines, Super Charging/Turbo charging, Air filters, Fuel Systems: Petrol Engines: Carbureted and MPFI, Ignition Systems: Conventional and Electronic, Diesel Engines: Conventional, CRDI, and Duel Fuel engines., Performance, Combustion and Exhaust Emissions, Air pollution and their control: EGR and Catalytic Converters, EURO/Bharat Stage Norms: I, II, III, IV and V., Manifolds and Mufflers, Engine Cooling and Lubrication.

Clutch: Necessity, Clutch Assembly: Construction and Working Principle, Types: Single and Multiple Plates, Free-Play, Fluid coupling/Torque converter, Clutch Troubles and Remedies.

Gearbox: Necessity of Transmission and Transaxle, Construction and Working Principle, Selector Mechanism, Types: Sliding mesh, Constant mesh, Synchromesh, and Epicyclical. Three, Four and Five- Speed Gearbox, Overdrive, Automatic Gearbox, Gearbox Troubles and Remedies.

Drive shaft and Final Drive: Drive Shaft: Constructional Features: Universal/Hooks Joints, Slip Joint, and Working Principle., Types of Propeller shafts, Final drive and Differential: Necessity, Constructional Features and Working Principle., Front/Rear Axles: Constructional Features and Types of Rear Axle Floating, Wheels: Disc and Drum type, Tires: Tire Construction, Tube and Tubeless Tires, Radial Tires, Tire specification, Tire rotation and Tire Maintenance.

Suspension System and Vehicle Control: Coil and Leaf Springs, Shock absorbers, Wheel alignment: Kingpin angle, Caster, Camber, Toe-in, and Toe-out., Necessity of vehicle control, Steering Mechanism and its Elements: Steering gear box and its types, Steering gear ratio, Constant Velocity Joints and linkages. Power Steering, Brake system: Necessity, Parking and Power Brakes, Parts and Working Principle of Mechanical, Air and. Hydraulic Brakes: Mater and Wheel cylinder, Properties of Brake Fluids, Brake Diagnostics and Service: Brake Bleeding, Anti-lock Braking System, Automobile Accessories and Tips for Safe Driving.

Electrical and Electronic Systems: Basics of Electrical/Electronic Systems: Battery, Starting system, Charging System, Lighting and Signaling System, A/C Electrical System, Electronic Engine Management system, Automotive Embedded Systems: Vehicle Security System and Working Principle of Computer Sensors: Temperature, Flow, Cam, knock, and Oxygen, and ECU/ ECM.

Trouble Shooting and Maintenance: Engine and Vehicle Troubles: Diagnostic Information: Symptom descriptions and their Causes and Remedies, Periodic, Preventive and Break down Maintenance: Engine tuning, Fuel and Air filters, Lubricants, Maintenance of Battery and Electrical/Electronic System, and Tires. The Motor Vehicle Act (India).

Text Books:

1. Automotive Mechanics (10/e) - William H. Crouse and Donald L. Anglin, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-059054-0
2. Automobile Engineering – KK Jain/ RB Asthana, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-044529-X
3. Internal Combustion Engines and Air Pollution- E.F. Obert, Harper & Row International Publishers Inc., ISBN: 0-06-350561-4

Reference Books:

1. Automotive Mechanics – S. Srinivasan, Tata McGraw-Hill Publishing company Limited, ISBN: 0-07-044941-6
2. Internal Combustion Engines – Heywood, John, B. McGraw-Hill Publications Limited.
3. Automotive Engines- S Srinivasan, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-040265-5

(C) TOOL DESIGN

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5Th Ses. : 30Exam: 70

Examination (Theory): 3hrs. Credits: 4

Course Objective:

To demonstrate the basic knowledge of machine tools and understand designing concepts of Locating and Clamping Devices, Jigs & Fixtures, Press Tools. To give students the knowledge of designing forming dies and gauges.

Course Outcomes:

CO-1	Students will able to understand the basic principles of tool holding and guiding devices.
CO-2	Students will learn how to design a jig and fixture.
CO-3	Students will be able to learn about various tools used for NC and CNC.
CO-4	Students will be able to design forming dies and gauges.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2			1	2		2	
CO2	2	3	3	3	2			1	2		2	
CO3	2	3	3	3	3			1	2		2	
CO4	2	3	3	3	3			1	2		2	

Locating and Clamping Devices: Principles of Jigs and Fixtures design-Locating principles-Locating elements-Standard parts-Clamping devices-Mechanical actuation-Pneumatic & hydraulic actuation-Analysis of clamping forces-Tolerance and error analysis.

Jigs & Fixtures: Drill bushes-Different types of Jigs-Plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs- Automatic drill jigs-Rack & Pinion Operated, Air operated Jigs Components.

General principles of lathe, milling and broaching fixtures-Grinding, Drilling and shaping fixtures, Assembly, Inspection and Welding fixtures-Modular fixtures. Design and development of Jigs and fixtures for simple components.

Press Tools: Press working terminology-Presses and Press accessories-Computation of capacities and tonnage requirements-Design and development of various types of cutting, forming and drawing dies.

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control

Design of Limit Gauges: Elements, types and application of limit gauges, Gauge materials, their selection, Taylor's principles of gauge design, Types and methods to provide gauge tolerances. Design steps and design of plug & ring / snap gauge for given dimension and application.

Text Books:

1. Donaldson. C, Tool Design, Tata McGraw-Hill, 1986
2. “ASTME Handbook of Fixture Design ". Prentice Hall of India Pvt. Ltd.
3. Basu, Mukherjee, Mishra, Fundamentals of Tool Engg. Design, Oxford & IBH Publishing, N. Delhi

References:

1. A. K. Goroshkin, " Jigs and Fixtures Handbook ", Mir Publishers, Moscow, 1983.
2. “Die Design Handbook ", Ivana Suchy, McGraw Hill Book Co., 2005.
3. Production technology, HMT, Tata McGraw Hill.
4. P. Eugene Ostergaard, “Basic Die Making” - Mc Graw Hill Book, 1963.
5. Principle of Machine Tool. Sen & Bhattacharya, New Central Book Agencies, 1975.
6. Production tooling equipments S. N. Parsons, Macmillan, 1966. ।

(D) PRODUCTION PLANNING AND CONTROL

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course objectives:

To make the student Understand

- The production planning and inventory control systems through a managerial perspective.
- How operations managers allocate the resources using long term capacity planning, aggregate production planning, and inventory analysis.
- To recognizing the relationships among the strategic, tactical and operational levels of planning in production systems.
- Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP) by teaching the logic and mathematical foundation behind these tools.

Course Outcomes:

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

CO-1	Learn the basics about managerial aspects of operations & Production, this will help them in understanding the actual business process.
CO-2	Formulate the problem of production planning and inventory control and discuss the difficulties in real life cases.
CO-3	Do production planning system structure, inputs of the system, forecasts and cost data, the solution methods and techniques and the interpretation of the outcomes.
CO-4	Solve inventory management system structure, inputs of the system, the solution models and techniques and the interpretation of the inventory policies under deterministic and stochastic environments.
CO-5	Learn the recent developments in the areas of Materials Requirement Planning (MRP), Materials Requirement Planning II (MRP-II).

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO-1	1		2		1			1	3		3	
CO-2	1		2		2			1	3		3	
CO-3	2		3		1			1	2		3	
CO-4	1		3		1			1	3		2	
CO-5	2		3		1			1	3		1	

Production Planning and Control: Introduction-Definition-Functions of PPC- Objectives-Terminology- Types of Production-Production Control Department in Relation to Types of Production.

Forecasting: Introduction- Statistical forecasting techniques- Moving average-Exponential smoothing technique-Errors in forecasting and evaluation of fore casting techniques.

Process Planning, Computer aided Process Planning: production Control Procedures-Order, Flow , Load and Block types of Control-Production control Organization-Place and Significance of Production control Department in an Industry.

Inventory Management: Introduction-Definition - Types of Inventory - EOQ and EBQ Models with and without shortages - Buffer stock, Re-order Level- Inventory control techniques - Make or buy decision - Material requirement planning- MRP-II- JIT.

Planning: Engineering aspects-Aggregate Planning- Master Processing instructions- Identification Systems- Production inventory programs- work design and job design-
Routing-Steps in routing- Rout sheet.

Scheduling: Forward and Backward Scheduling- Master Scheduling- Evaluation of Job Shop Schedules with reference to Priority Scheduling rules, Sequencing, Assignment techniques in Production Scheduling.

Dispatching and Expediting: Centralized and Decentralized Dispatching- Functions in Dispatching- Dispatching policies- Progress reports- Gantt Load Charts and Schedule Charts- Use of components for production control other information processing systems- Computers in PPC

Text Books:

1. Joseph and Mork - Operations Management.
2. Donald Denmar - Management of Industrial Organization.
3. Moor and Deblonke - Production Control
4. Temokhna. J. A and White - Facilities Planning**.**
5. Everette.Adam, Jr. and Ronald J. Ebert- Production and Operation Management

References:

1. Production Planning and Inventory Control, Narasimhan, Mc Leavy, Billington, PHI(1999)
2. Operation Management- Strategy and Analysis, Lee Krajewski and Larry P. Ritzman, Addison-Weslely (2000).
3. Operations Management : Theory and Problems by Monk, J.G., McGraw Hill, NY, 1985.
4. Computer Aided Production Management, P. B. Mohapatra, PHI (2001)
5. Manufacturing Planning and Control Systems by Vollmann, Thomas, E. and Others, Richard D. Irwin, Illinois, 1984.
6. Service Operations Management by Fitzsimmons, J.A. and Sullivan, R.S., McGraw Hill, NY, 1982.
7. Materials Management by Ammer, Dean, S., Richard D. Irwin, Illinois, 1962.

(E) ROBOTICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course objectives:

- To familiarize the students with the automation and brief history of robot and applications.
- To give the students the knowledge of kinematics of robots, robot end effectors and their design, various Sensors and their applications in robots.
- To make them learn about Robot Programming methods & Languages of robot.

Course outcomes:

The students will be able to

CO-1	Define a robot and analyze various components of it.
CO-2	Do kinematics analysis of robot manipulators
CO-3	Understand the importance of robot dynamics, Robot end effectors and their design concepts
CO-4	Describe different mechanical configurations of robot manipulators.
CO-5	Apply the principles of various Sensors and their applications in robots.
CO-6	Understand the Programming methods & various Languages of robots.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	3	1	3	2		1		1	2		2
CO-2	3	3	3	2	2				1	1	1	
CO-3	1	2	3	2	2	1	1		2	2	1	1
CO-4	2	1	3	2				1	2	1	2	2
CO-5	3	2	3	3	2	2	3	2	2	2	1	2
CO-6		2		1	3			1	1			2

Introduction: Background- Historical Development-Robot Arm kinematics and Dynamics-Manipulator Trajectory Planning and Motion Control-Robot Sensing- Robot Programming Language-Machine Intelligence.

Robot Arm kinematics: Introduction – The Direct Kinematics Problem-The Inverse Kinematics Solution.

Robot Arm Dynamics: Introduction – Lagrange-Euler Formulation- Newton-Euler Formation - Generalized D'Alemberts Equations of Motion.

Planning of Manipulator Trajectories: Introduction-General Considerations on Trajectory Planning- Joint Interpolated Trajectories- Planning of Manipulator Cartesian Path Trajectories.

Control of Robot Manipulators: Introduction – Control of the Puma Robot arm- Computed Torque Technique- Near Minimum Time Control- Variable Structure Control- Nonlinear Decoupled Feedback Control- Resolved Motion Control- Adaptive Control.

Sensing: Introduction-Range Sensing-Proximity Sensing- Touch Sensors- Force and Torque Sensing.

Low-Level Vision: Introduction –Image acquisition- Illumination Techniques- Imaging Geometry- Some Basic Relationship Between Pixels – Preprocessing.
Robot Programming Languages: Introduction- Characteristics of Robot Level Languages- Characteristics of Task Level Languages.

Text Book:

1. Robotics By K.S. Fu, R.C. Gonzalez and C.S.G Le, McGraw- Hill International Editions1987.

Reference Books:

1. Industrial Robotics By M.P.Groover,Mitchell Weiss, Roger N. Nagel and N.G.Odrey, McGraw-Hill International Editions1986.
2. Robot Analysis- The Mechanics of Serial and Parallel Manipulators By Lung-Wen Tsai, Jhon Wiley and Sons,Inc

(E) MECHATRONICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 5Th Ses. : 30Exam : 70

Examination (Theory): 3hrs. Credits: 4

Course Objectives:

To impart the knowledge of integrated design issues in Mechatronics and Mechatronics design process and the basic knowledge of modelling and simulation of block diagrams and also about sensors, transducers, signals and system controls. The objective is also to make them aware of advanced applications in mechatronics.

Course Outcomes:

The students will be able to:

CO-1	Design the mechatronics systems.
CO-2	Model and simulate the block diagrams of systems.
CO-3	Gain knowledge of operation of different sensors and transducers for various applications.
CO-4	Gain knowledge in application of Artificial intelligence and micro sensors in mechatronics

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1			2	1	2		1	1
CO2	3	3		3				1	2		1	
CO3	1	1	1							2	2	1
CO4	1	1	1		1		2		3		3	2

.

Mechatronics system design: Introduction to Mechatronics: What is mechatronics, Integrated design issues in mechatronics, Mechatronics key elements, The mechatronics design process, Advanced approaches in mechatronics.

Modelling and simulation of physical systems: Simulation and block diagrams, Analogies and impedance diagrams, Electrical systems, Mechanical translational systems, Mechanical rotational systems, Electromechanical coupling, Fluid systems.

Sensors and transducers: An introduction to sensors and transducers, Sensors for motion and position measurement, Force, torque and tactile sensors, Flow sensors, Temperature-sensing devices. Actuating devices: Direct current motor, Permanent magnet stepper motor, Fluid power actuation.

Signals, systems and controls: Introduction to signals, systems and controls, System representation, Linearization of nonlinear systems, Time delays.

Real time interfacing: Introduction, Elements of a data acquisition and control system, Overview of the I/O process, Installation of the I/O card and software.

Advanced applications in mechatronics: Sensors for condition monitoring, Mechatronic control in automated manufacturing, Artificial intelligence in mechatronics, Microsensors in mechatronics.

Text Book:

1. Mechatronics System Design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing Company, 2001.

References:

1. Mechatronics by W. Bolton, Pearson Education, Asia, II-Edition, 2001
2. Introduction to Mechatronics and Measurement Systems by David G. Alciatore and Michael B. Histand, Tata McGraw Hill Company Ltd.

MEC 327 - METROLOGY LAB./MECHATRONICS LAB.

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Sess. : 50 Exam : 50

Examination (Practical): 3hrs. Credits: 2

Course Objectives:

- To teach students the process of calibrating the instruments using higher standard
- To teach students the method of measuring taper angle, flatness of surface using different instruments and also to measure gear tooth parameters.
- To make students to learn to do alignment tests on spindle.
- To expose them to the use of Tool-makers microscope for measuring smaller dimensions.
- To expose students to programmable logic controllers.
- To provide students the knowledge of sensors and transducers.

Course Outcomes:

Student will be able to

CO-1	Calibrate the given instruments
CO-2	Measure taper angle, flatness of surface and gear tooth parameters
CO-3	Conduct concentricity and roundness test on spindle.
CO-4	Use Tool maker's microscope for measuring smaller dimensions.
CO-5	Select suitable sensors and transducers while designing a system to meet specified requirements.
CO-6	Interface the programmable logic controller with input/output components for various practical applications.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2				3	1	1		
CO2	1	1		2				2	1	1		
CO3	1			2				2	1	1		
CO4				3				2	1	1		
CO5	1	1	1					1	1	1	2	1
CO6	3	3	3		3	1			2		3	2

METROLOGY LAB. EXPERIMENTS - (Any Five)

1. Calibration of the following instruments: (using slip gauges)
   i. Calibration of Micrometer. ii. Calibration of Mechanical Comparator.
   ii. Calibration of Vernier Caliper. iv. Calibration of Dial Gauge.

2. Measurement of taper angle using
   i. Bevel Protractor ii. Dial Gauge iii. Sine-Bar iv. Auto-Collimator.

3. Alignment tests:
   ii. Parallelism of the spindle ii. Circularity & Concentricity of the spindle
   iii. Trueness of running of the spindle.

4. Gear parameters Measurement
   i. diameter, pitch/module ii. Pitch circle diameter iii. Pressure angle
   ii. Tooth thickness.

5. Check the flatness of a surface plate.
   i. Using spirit level ii. Using Auto-collimator

6. Using light wave interference:
   i. Study of flatness of slip gauges ii. To find the height of a slip gauge.

7. Tool Maker's Microscope:
   i. Establish the thread details ii. To find the cutting tool angles.

8. Miscellaneous:
   i. To find the diameter of a cylindrical piece ii. Taper angle of a V-block
   ii. Central distance of two holes of a specimen.

MECHATRONICS LAB. EXPERIMENTS - (Any Five)

I. Training on Programmable Logic Controller (any ONE of the Following)
   i) Lift Control Using Ladder Logic Programme
   ii) Traffic Signal Control using Ladder Logic Programme

II. Training on Programmable Logic Controller - Sensor Training Kit
   a) Proximity Switch
   b) Photo Electric Switch
   c) Limit Switch

III. Training on Sensor and Transducer (any ONE of the Following)
   i). Linear position or Force applications
      a. LVDT (Linear variable differential transformer)
      b. The strain gauge Transducer
   ii). Rotational Speed or Position Measurement (The inductive Transducer)
   iii). Linear or Rotational Motion
      a. D.C. Solenoid
      b. D.C. Relay

IV. Training on Automation Studios
   i). Punch Machine operation
   ii). Hydraulic Cylinder operation

V. Training on Material Handling

VI. Training on any Controller Package

VII. Training on Servo Fundamental Trainer.

MEC 328 - INDUSTRIAL ENGINEERING LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits: 2

Course objectives:

- To acquaint the student with concepts of industrial engineering related to work study experiments
- To acquaint the student with concepts of industrial engineering related to time study experiments
- To acquaint the student with concepts of industrial engineering related to quality control experiments

Course outcomes:

CO-1	Students will be able to understand the principles of work study.
CO-2	The student will be able to learn the concepts of work study which are commonly used in any Industry
CO-3	The student will be able to learn the concepts of quality control

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1		3						3		3	
CO-2	1		3						3		3	
CO-3	2		3						3		3	

List of Experiments:

1. To measure the skill and dexterity in the movement of Wrist and Fingers using pin board.
2. To measure the Heart beat using Stethoscope.
3. To show that the sample means from a normal universe follow a normal distribution.
4. To draw the control chart for fraction defective for a given lot of marble balls.
5. To determine the cycle time using PMTS.
6. To draw two handed process charts for
    i. Bolt, Washer and nut assembly
    ii. Assembly of electric tester.
7. To study the changes in heart rate for different subjects using Tread mill.
8. To draw Multiple Activity chart using an electric toaster.
9. To determine the percentage utilization using work sampling.
10. To study the process capability of a given process.
11. To measure the Heart rate during working and recovery periods of the subjects under different loads, using Bicycle ergometer.
12. To draw flow process charts on activities in Workshop/ Laboratory/Office.
13. To determine the time required to perform motion sequence using work factor system.
14. To draw SIMO charts for
    i. Ball point pen assembly
    ii. Electric plug assembly.
15. To conduct time study of the bulb holder assembly operation of the existing method.
16. To collect the anthropometrics data using `Anthropolometer'.

MEC 411 – DESIGN OF MACHINE ELEMENTS - II

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To develop an ability to design a component, or a system, or a process to meet desired needs within realistic constraints.
- To develop an ability to select and design gears for efficient power transmission in different applications.
- To impart the fundamental knowledge involved in analyzing the forces acting on any component of an I.C. Engine and design them for their strength.
- To provide the basic design concepts for design of such components like Clutches, bearings, gears, chain drives and wire ropes used in power transmission.

Course Outcomes:

The Student will be able to:

CO-1	Design the various types of gears based on static and dynamic Loading.
CO-2	Design the various IC engine components like connecting rod, crankshaft etc subjected to combined Stresses.
CO-3	Design various types of Frictional Clutches and brakes used in Automobiles.
CO-4	Design and Analyze the Life of the bearings subjected to static and Dynamic Loads.
CO-5	Design Crane hook, wire ropes and chain drives subjected to various types of loads.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2						1	1
CO2	3	1	3	1	2						1	1
CO3	3	1	3	1	2						1	1
CO4	3	1	3	1	2						1	1
CO5	3	1	3	1	2						1	1

Classification of gears. Standard tooth systems. Spur, Helical, Bevel and Worm gears. Terminology of each. Tooth failure. Face width an beam strength. Lewis equation. Design for dynamic and wear loads. Force analysis of Bevel and Worm gears. Thermal design considerations of worm gears.

Engine parts: I.C. engine design. Design of cylinders and heads. Design of pistons. Design of cross-head, connecting rods and crank shafts.
Friction clutches. Torque capacity multi-plate clutches. Design considerations. Energy considerations and Temperature rise friction materials. Centrifugal clutches. Brakes. Energy equations. Band and block brakes. Internal expanding shoe brakes, self locking, brake design.
Sliding contact bearings. Lubrication modes. Temperature effect on viscosity. Journal bearing design. Bearing modulus. McKee equations. Heating of bearings. Collar and thrust bearings. Roller and ball bearings. Static and dynamic load capacity. Equivalent bearing load. Load-life relationships. Load factor. Selection of bearings from manufacturers catalogue.
Design of crane hooks, Wire rope construction and classification. Stresses in wire ropes. Design for service like lifts and winches. Chain drives, Nomenclature: Brief outline and simple applications of composite materials.

Text books:

1. Design of Machine Elements by V.B. Bhandari, TMH publishing Co. Ltd., New Delhi.

References:

1. Machine Design by R.K. Jain, Khanna publications.
2. Mechanical Engineering Design by Joseph E. Shingley.

MEC 412 – HEAT AND MASS TRANSFER

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs Credits : 4

Course Objective:

To demonstrate basic knowledge of heat transfer by understanding different modes of heat transfer, thermal conductivity of materials, composite walls, cylinders and spheres, heat transfer in fins, steady and unsteady heat conduction, applications of non dimensional numbers in free and forced convection, thermal boundary layer, radiation heat transfer, concept of shape factor, parallel & counter flow heat exchangers, basic principles of mass transfer.

Course Outcomes:

CO-1	Students will able to understand the basics of steady and unsteady state heat conduction and its applications.
CO-2	Students will able to understand the basics of free and forced convection and its applications.
CO-3	Students will able to understand the basics of radiation and its applications.
CO-4	Students will able to understand the basics of steady mass transfer and its applications.
CO-5	Students will able to design thermal equipment such as Fins, Heat Exchangers etc.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	3			2	1	1		1	
CO2	1	3	3	3			2	1	1		1	
CO3	1	3	3	3			2	1	1		1	
CO4	1	3	3	3			2	1	1		1	
CO5	1	3	3	3	1		2	1	2		3	

Introduction: Basic modes of heat transfer- Rate equations- Generalized heat conduction equation in Cartesian, Cylindrical and Spherical coordinate systems.

Steady state heat conduction solution for plain and composite slabs, cylinders and spheres- Critical thickness of insulation- Heat conduction through fins of uniform and variable cross section- Fin effectiveness and efficiency.

Unsteady steady state heat conduction- Transient heat conduction- Lumped system analysis, and use of Heisler charts.
Convection: Continuity, momentum and energy equations- Dimensional analysis- Boundary layer theory concepts- Free, and Forced convection- Approximate solution of the boundary layer equations- Laminar and turbulent heat transfer correlation- Momentum equation and velocity profiles in turbulent boundary layers- Application of dimensional analysis to free and forced convection problems- Empirical correlation.
Radiation: Black body radiation- radiation field, Kirchoff's laws- shape factor- Stefan Boltzman equation- Heat radiation through absorbing media- Radiant heat exchange, parallel and perpendicular surfaces- Radiation shields.
Heat Exchangers: Types of heat exchangers- Parallel flow- Counter flow- Cross flow heat exchangers- Overall heat transfer coefficient- LMTD and NTU methods- Fouling in heat exchangers- Heat exchangers with phase change.
Boiling: Different regimes of boiling- Nucleate, Transition and Film boiling. Condensation: Laminar film condensation- Nusselt's theory- Condensation on vertical flat plate and horizontal tubes- Dropwise condensation.
Mass Transfer: Conservation laws and constitutive equations- Isothermal equimass, Equimolal diffusion- Fick's law of diffusion- diffusion of gases, Liquids- Mass transfer coefficient.

Text Books:

1. Heat Transfer, by J.P.Holman, Int. Student edition, McGraw Hill book company.
2. Analysis of Heat transfer, by Eckert and Drake, Int.Student edition, McGraw Hill Kogakusha Ltd.

References:

1. Heat and Mass Transfer by R.K. Rajput, S. Chand & Co.
2. Heat and mass transfer by Sachjdeva.
3. Heat and mass transfer by Kothandaramanna, New Age International.

MEC 413 – FLUID MACHINERY AND SYSTEMS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

To make the students to apply the knowledge of mathematics, science, and engineering to Fluid machinery and measure the forces exerted by the jet of water on various vanes. Also to make them understand the principles of hydraulic turbines, pumps and other equipments.

Course Outcomes:

Students will be able

CO-1	To Analyze the forces exerted by the jet on various stationary and moving vanes.
CO-2	To Determine the performance of different propulsion systems.
CO-3	To study and analyze the performance characteristic curves of hydraulic turbines and pumps at different working conditions.
CO-4	To Understand and analyze the performance of various hydraulic systems such as Hydraulic lift, ram etc.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					1		1	1
CO2	3	2	3	3					1	2	1	
CO3	3	3	3	3		2	2	2	1	2	1	
CO4	3	3	3	3		2	2	2	1	2	1	

Impact of jet and jet propulsion: Impact of jet on stationary surfaces- Impact of jet on hinged surfaces- A moving curved vane high tangential entry of water- Radial flow over the vanes- Jet propulsion.

Hydraulic Turbines: Classification- Pelton wheel- Reaction turbines- Inward and outward radial flow reaction turbines- Fancis turbine- Axial flow reaction turbine- Kaplan turbine- Draft tube- Types- Theory- and efficiency of draft tube.

Specific Speed: Determination- Significance- Unit quantities- Unit speed- Unit discharge and unit power- Characteristic curves of hydraulic turbines- Constant heat curves- Constant speed curves and Iso-efficiency curves- Governing of turbines.

Centrifugal Pumps: Main parts- Efficiency- Minimum speed for starting- Multi-stage centrifugal pumps- Specific speed of a centrifugal pump- Priming of a centrifugal pump- Characteristic curves- Main, Operational and constant efficiency curves- Cavitation- Effects- Cavitation in Hydraulic machines.
Reciprocating Pumps: Main parts- Classification- Velocity and acceleration variation in suction and delivery pipes due to piston acceleration- Effect of variation of velocity on friction in suction and delivery pipes- Effect of acceleration in suction and delivery pipes on indicator diagram- Effect of friction- Maximum speed of reciprocating pump- Air vessels.
Hydraulic Press- Hydraulic accumulator- Differential hydraulic accumulator- Hydraulic intensifier- Hydraulic ram- Hydraulic lift- Hydraulic crane- Fluid coupling- Hydraulic torque converter. Servo systems- Open and closed loop systems- Hydraulic and Pneumatic systems- Fluid power components- Fluidics- Efficiency of a fluidic device- Proportional or analog devices- Vortex diode, Vortex triode, Counting, Fluidic systems- Digital devices.

Text Book:

1. Fluid Mechanics and Hydraulic Machinery, by R.K.Bansal, Laxmi publications.

Reference:

1. Fluid Flow Machines, by N.S.Govinda Rao, Tata McGraw Hill publishing company Ltd.

MEC 414 – STATISTICAL QUALITY CONTROL

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

- To acquaint the student with the basic knowledge of statistical quality control by understanding quality definitions, Taguchi's loss function Demings philosophy
- To prepare control charts for variables, X,R and Sigma charts, theory of runs, ARL and ATS , Type-I and Type-II errors,
- To prepare control charts for attributes, P-Chart, np-chart,c-chart, u-chart,
- To Design single and sequential sampling plans

Course Outcomes:

CO-1	Students will able to understand Taguchi's, Deming's principles.
CO-2	Students will be able to understand how to use the control charts and their significance
CO-3	Students will be able to understand how to use the sampling plans and their significance

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	1		3	1	2				3		3	
CO-2	1		3	1	2				3		3	
CO-3	1		3	1	2				3		3	

Introduction to quality, definitions, Taguchi's loss function, examples of off-line and on-line quality control techniques, quality costs, Deming's philosophy, introduction to six sigma concept.

Shewart's normal bowl, control charts for variables, $\overline{X}$, R and sigma control charts, theory of runs, ARL and ATS, Type-I and Type-II errors

Control charts for attributes, p-chart, standardized p –chart, np-chart, c-chart, u-chart, demerit control chart.

Process capability analysis: using frequency distribution and control charts. Process capability ratios, C_p and C_{pk} Process capability ratios for nominal the batter type, smaller the better type and larger the better type product specifications.

Sampling palns: single, double, multiple and sequential sampling plans, rectifying inspection, AOQ, AOQL, and ATI. Use of Dodge Romig Tables, Design of single and sequential sampling plans.

Text Books:

1. Introduction to statistical quality control by E.L. Grant
2. Introduction to statistical quality control by D.C. Montgomery

MEC 415 - ELECTIVE - III

MEC 415(C) – Computer Numerical Control and Computer Aided Manufacturing

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

1. To provide an introduction to the basic principles of computer integrated manufacturing and functioning of its components.
2. To strengthen the student's knowledge in the application of computerized numerically controlled machines in the areas of automobile components manufacturing, dies and moulds and other precision component manufacturing.
3. To make students understand features of different computer aided quality inspection methodologies and flexible manufacturing systems.
4. To impart basic concepts related to manual part programming through the use of loop statements in "C"-Language programming.
5. To expose students to execute simulations in cam software prior to machining in computerized numerically controlled machines.

Course Outcomes:

CO-1	Students will have clear idea about the principles of computer aided manufacturing and its functioning.
CO-2	Students can explain the significance of various methodologies that can be adopted in process planning and quality control.
CO-3	Students will have the ability to explain the operational features of group technology and components of flexible manufacturing and tool management systems.
CO-4	Students will be able to reach latest advancements in precision manufacturing by building upon the fundamentals learnt in this course.
CO-5	Students will learn the principles related to manual part programming and computer aided part programming for controlling various computerized numerically controlled machines.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	-	-	2	1	3	-	1	1	1	3	2	3
CO-2	2	3	3	3	1	-	-	2	2	3	3	3
CO-3	3	2	1	1	2	-	-	1	2	3	2	2
CO-4	3	-	1	2	3	-	-	2	3	2	3	3
CO-5	-	-	1	3	3	-	-	1	3	3	3	3

Introduction to CNC and CAM, CNC retrofitting, Adoptive control machining, NC part program preparation through computer languages. Group technology: Merits & demerits, Organisation, Classification and Coding systems, Facilities layout.
Computer aided process planning: Introduction to process planning, Methods of process planning, Computer aided process planning, CAPP systems, case studies.
Computer aided material handling and production planning: Robots: Structure and operation of Robots, robot sensors and applications. Automatic conveyor systems. Automated guided vehicles. Aid of computer in production planning and control, Inventory control and material requirement planning.
Computer aided inspection and quality control: Developments and practice, Quality assurance and quality control. Coordinate measuring machine. Non-contact inspection.
FMS & CIMS: Building blocks of Flexible Manufacturing Systems (FMS), Machining systems of FMS, Tool management systems, Advantages of FMS, Computer integrated manufacturing systems (CIMS).

Text Books:

1. Computer Aided Manufacturing, by P.N.Rao, N.K.Tewari & T.K.Kundra, Tata McGraw-Hill publishing company Ltd, NewtDelhi.
2. Automation, Production Systems and Computer Integrated Manufacturing, by Mikell P.Groover, Prentice-Hall of India Pvt. Ltd.

Reference:

1. Computer Integrated Design and Manufacturing, by David D.Bedworth, Mark R.Henderson & Philip M.Wolfe, McGraw-Hill Book Company, Singapore.

MEC 415 - ELECTIVE - III
MEC 415(D) – TOTAL QUALITY MANAGEMENT

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70
Examination (Theory): 3hrs. Credits : 4

Course objectives:

To give a brief theoretical knowledge related to concepts of Quality , concepts of TQM, Quality philosophies, to illustrate TQM process, quality control tools, Quality policy deployment, Designing for Quality.

To demonstrate the steps for Implementation of TQM, focusing on KAIZEN,5S,JIT,Taguchi methods, by giving case studies from the Industry.

Course outcomes:

CO-1	Students will be able to understand the various Quality concepts, the role of the Top Management, for the successful implementation of TQM
CO-2	Students will be able to understand the various TQM concepts
CO-3	Students will be able to understand the various Quality systems like ISO 9000 systems
CO-4	Students will be able to understand the various Quality concepts like KAIZEN
CO-5	Students will be able to understand the various Quality concepts like Taguchi methods

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1		3	1	1				3		3	
CO-2	1		3	1	2				3		3	
CO-3	1		3	2	2				3		3	
CO-4	1		3	1	1				3		3	
CO-5	1		3	1	1				3		3	

Concepts of TQM: Philosophy of TQM, Customer focus, Organization, Top management commitment, Team work, Quality philosophies of Deming, Crossby and Muller.
TQM process: QC tools, Problem solving methodologies, New management tools, Work habits, Quality circles, Bench marking, Strategic quality planning.
TQM systems: Quality policy deployment, Quality function deployment, Standardization, Designing for quality, Manufacturing for quality.
Quality system: Need for ISO 9000 system, Advantages, Clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality auditing, Case studies.

Implementation of TQM: Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, Case studies.

References:

1. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993.
2. The Essence of Total Quality Management by John Bank, PHI, 1993.
3. Beyond Total Quality Management by Greg Bounds, Lyle Yorks et al, McGraw Hill, 1994.
4. The Asian Productivity Organization by Takashi Osada, 1991.
5. KAIZEN by Masaki Imami, McGraw Hill, 1986.

MEC 415 - ELECTIVE - III
MEC 415(E) – OPTIMIZATION OF DESIGN

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70
Examination (Theory): 3hrs. Credits : 4

Course Objective:

To objective of the course is to familiarizing the students with optimization in design principles such as classical optimization techniques, nonlinear programming, dynamic programming, integer programming, and geometric programming to solve engineering problems.

Course Outcome:

CO-1	The Students will be able to model, solve and analyze problems using the concepts of non linear programming
CO-2	The Students will be able to model, solve and analyze problems using the concepts of dynamic programming
C0-3	The Students will be able to model, solve and analyze problems using the concepts of geometric programming
CO-4	The Students will be able to model, solve and analyze problems using the concepts of integer programming

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1		3		3			3	3		3	
CO-2	2		3		2			3	3		3	
CO-3	1		2		3			2	1		3	
CO-4	1		1		3			1	2		1	

Introduction to Optimization: Engineering applications of optimization- Statement of an optimization problem- Classification of optimization problem- Optimization techniques.
Classical Optimization Techniques: Single variable optimization- Multivariable optimization with equality constraints- Multivariable optimization with inequality constraints.
Nonlinear Programming: One-Dimensional Minimization: Unimodal function- Elimination methods- Unrestricted search- Exhaustive search- Dichotomous search- Fibonacci method- Golden section method- Interpolation
methods- Quadratic interpolation method- Cubic interpolation method- direct root method.
Nonlinear Programming: Unconstrained Optimization Techniques: Direct search methods- Random search methods- Univariate method- Pattern search method- Rosenbrock's method of rotating coordinates- The simplex method- Descent methods- Gradient of function- Steepest

descent method- Conjugate gradient method (Fletcher-Reeves method)- Quasi-Newton methods- Variable metric method (Davidon- Fletcher-Powell method).
Nonlinear Programming: Constrained Optimization Techniques: Characteristics of a constrained problem- Direct method- The complex method- Cutting plane method- Methods of feasible directions- Indirect methods- Transformation techniques- Basic approach in the penalty function method- Interior penalty function method- Convex programming problem- Exterior penalty function method.
Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P). Complimentary geometric programming(C.G.P)
Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimisation, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P., Continuous D.P.
Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Integer non linear programming.

Text Book:

1. Optimization Theory and Applications, by S.S.Rao, Wiley Eastern Limited, New Delhi.

References:

1. Optimization of Design of Machine Elements, by R.C.Johnson.
2. Computer Aided Analysis and Design of Machine Elements, by Rao V.Dukkipati, M.Ananda Rao and R.B.Bhat.
3. Engineering optimization methods and applications, by G.V.Reklaits, A.Ravindarn and K.M.Ragsdell, by Publications John Wiley and Sons.

MEC 415 - ELECTIVE - III
MEC 415(F) – ENGINEERING TRIBOLOGY

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70
Examination (Theory): 3hrs. Credits : 4

Course objectives:

- To provide broad based understanding of the interdisciplinary subject 'Tribology' and its technological significance.
- To make students learn the principles for selecting compatible materials for minimizing friction and wear in machinery.
- To make students understand the fundamental principles of lubrication for reduction of friction and Wear.
- To give students understanding of the principles of bearing selection and bearing arrangement in machines.
- To teach students the computations required for selecting and designing bearings in machines.

Course outcomes:

The students will be able to:

CO-1	Apply the basic theories of friction, wear and lubrication to predictions about the frictional behaviour of commonly encountered sliding interfaces.
CO-2	Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.
CO-3	Interpret the latest research on new topics in Tribology including its application to nano scale devices and biological systems.
CO-4	Relate the composition of lubricant film and its properties and operational conditions such as load, temperature and speed to make correct designs for the applications in the industry
CO-5	Calculate and measure properties of contacting surfaces such as roughness, friction coefficient and adhesive strength.
CO-6	Understand the tribological applications of metals, polymers, ceramics and bio materials.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	1	2	1	1		2		1	2		1
CO-2		1	2	3	3	2	1		2	1	1	1
CO-3	1	2	3	3	1	3	1	1		1	2	
CO-4	3	2	1	2	1	2		1		1	1	
CO-5	1	2		2	2	2	2		2	1	2	

Introduction: history, industrial significance, different types of bearings,

Properties and testing of lubricants: viscosity, viscometry, effect of temperature and pressure on viscosity, physical properties of mineral oils, generalized Reynolds's equation
Engineering surfaces – properties and measurements: different measuring methods, statistical description, fractal description
Surface contact: Non –confirming Surface contact geometry, stresses in Non –confirming Surface, contact of surface roughness, numerical surface contact models
Adhesion, Friction, Wear: adhesion models, factors influencing adhesion, stiction, various types of frictions, laws of wear, types of wear, minor forms of wear, methods for reduction of wear and friction and ferrography, surface engineering
Boundary lubrication: Liquid lubrication, fluid film lubrication, liquid and solid lubricants, properties of lubricants, typical lubricant tests, additives, Fluid film lubrication
Bearings: hydrodynamic thrust bearings, hydrodynamic journal bearings, hydrodynamic squeeze film bearings, hydrostatic bearings, gas lubricated bearings and rolling element bearings and antifriction bearing, Nano tribology

Text books:

1. Introduction to triobology of bearings, B.C. Majumdar, a.h. wheelers and co
2. Engineering triobology, Prasanta Sahu, Prentice - Hall of India, 2005
3. Fundamentals of Tribology, S.K.Basu, s.N. Sengupta and B.B.Ahuja, Prentice - Hall of India, 2005

MEC 417 - HEAT AND MASS TRANSFER LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits: 2

Course Objective:

To demonstrate basic knowledge of heat transfer by understanding different modes of heat transfer, thermal conductivity of materials, composite walls, cylinders and spheres, heat transfer in fins, steady and unsteady heat conduction, principles of radiation heat transfer.

Course Outcomes:

CO-1	Students will able to understand the basics of steady and unsteady state heat transfer and its applications.
CO-2	Students will able to understand how to calculate thermal conductivity for different materials for different heat input.
CO-3	Students will acquire knowledge about free and forced convection.
CO-4	Students will analyze the variation of temperature at different mediums.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3		2		1	2		2	
CO2	2	2	3	3		2		1	2		2	
CO3	2	2	3	3		2		1	2		2	
CO4	2	2	3	3		2		1	2		2	
CO5												

List of Experiments:

1. Study of conduction phenomena in the composite slab system.
2. Determination of emmissivity, time constant, Fouries Biot module and study of variation of temperature with respect to time on a circular disc.
3. Study of heat transfer by forced convection through a horizontal test section.
4. Study of heat transfer by forced convection through a vertical test section.
5. Determination of free convective heat transfer coefficient from a horizontal cylinder in air.
6. Determination of thermal conductivity of brass employing it as a fin.
7. Tests on natural convection and pool boiling.
8. Study of forced convection with turbulence promoters.
9. Study of condensation on fin.
10. Tests on film condensation.
11. Determination of COP of a vapour compression refrigeration system.
12. Study of vapour compression air conditioning system.

MEC 418 – FLUID MECHANICS AND MACHINERY LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits: 2

Course Objectives:

- To demonstrate the students to measure the flow rate by using various instruments like venturi meter, orifice meter and Notches etc.
- To make students to determine the performance characteristics curves of turbines and pumps.

Course Outcomes:

Students will be able to:

CO-1	Measure the flow rate and efficiencies of turbines and pumps at various working conditions.
CO-2	Understand the experiments and draw the various performance characteristic curves of hydraulic machines.
CO-3	Analyze and design fluid systems.
CO-4	Safely execute experiments, analyze and interpret results and errors, and formulate conclusions

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	3				2	2		2	1
CO2	3	3	3	2		1		1	1		1	
CO3	3	3	3	3		1	2	1	1	1	1	
CO4				3				3	2	3	1	

.

List of Experiments:

1. Calibration of flow meters,
    a. Venturi meter
    b. Orifice meter
    c. Nozzle meter
2. Determination of coefficient of discharge for
    a. small orifice
    b. cylindrical mouth piece
3. Finding coefficient of discharge for
    a. rectangular notch
    b. triangular notch

    c. trapezoidal notch
4. To draw the performance characteristics of C.F. pump.
5. To find the specific speed of
    a. Pelton turbine
    b. Francis turbine
6. To draw the characteristic curves for reciprocating pump.
7. To draw the pressure distribution and finding coefficient of drag for
    a. a bluff body
    b. an Aero foil
8. To draw the characteristic curves for the hydraulic ram.

MEC 421 – INSTRUMENTATION AND CONTROL SYSTEMS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Instrumentations: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain. pressure, flow, temperature and vibration.

Optical Methods of Measurement: Introduction, Laser beam as a light pointer, length/displacement measurement, temperature sensors, seismographic measurement.

Introduction to fiber optics, fiber types, properties of optical fibres and a fibre optic sensor configuration.

Introduction: Control systems, Feedback and its effects. Transfer Function, Block Diagram and Signal Flow Graph: Impulse response and Transfer functions of linear systems, Block diagrams.

Mathematical Modeling of Physical Systems: Equations of electrical networks, Modeling of mechanical system elements, Equations of mechanical systems. State-variable Analysis of Linear Dynamic Systems: Matrix representation of state equations, State transition matrix, State transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions, Characteristic equation, eigen values and eigen vectors.

Time-Domain Analysis of Control Systems: Typical test signals for the time response of control systems, Time- domain performance of control systems- The steady- state error, Time-domain performance of control systems- Stability of control systems- stability, Characteristic equation and the state transition matrix, Methods of determining stability of linear control systems, Routh- Hurwitz criterion.

Frequency-domain Analysis of Control Systems: Introduction, Nyquist stability criterion, Application of the Nyquist criterion, Stability of multi loop systems, Stability of linear control systems with time delays.

Text Books:

1. Automatic Control Systems, by Benjamin C. Kuo.
2. Mechanical Measurements, by R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi.

References:

1. Experimental Methods for Engineers, by J.P.Holman, McGraw-Hill.
2. Instrumentation for Engineering Measurements, by R.H. Cerni and L.E.Foster, J.Wiley & Sons, New York.
3. Mechanical and Industrial Measurement, by R.K.Jain, Khanna publishers, Delhi.
4. Control Systems Engineering by Nagrath/Gopal ,New age international.

MEC 422 – COMPUTER AIDED DESIGN

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

1. To enable students in using computers for design, analysis and optimization of machine elements.
2. To introduce synthesis and analysis phases of design using computers.
3. To educate students about various types of input-output devices of computers.
4. To introduce different modeling and analysis techniques to students.
5. To write algorithms for various design problems using CAD.

Course Outcomes:

Student will be able to

CO-1	Students can use 2D entities in drawing Machine Elements.
CO-2	Students can understand the difference between wireframe model, surface model and solid model.
CO-3	Students can implement FEM using CAD.
CO-4	Students can develop algorithms for Design Problems.
CO-5	Students can implement Artificial Intelligence to design problems using CAD.

Mapping of Course Outcomes with Programme Outcomes.

High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	-	1	-	3	-	-	-	-	2	-	-
CO-2	3	-	3	-	2	-	-	-	-	1	-	-
CO-3	3	2	3	3	3	-	2	-	2	1	-	1
CO-4	2	2	-	-	1	-	-	-	1	-	-	1
CO-5	-	-	-	-	3	-	1	-	-	-	-	-

Fundamentals of CAD - Introduction - The design process - Application of computers for design - Operating systems - Hardware in CAD: The design work station - I/O Devices - CAD system configuration - Creating database for manufacturing - Benefits of CAD.

Interactive Computer Graphics - Graphic display devices- Graphics system- Graphics standards - Graphical user interface- Transformation systems- windowing - clipping - 2D and 3D transformations - Linear transformation- Display files for 3D data - Geometric Modeling - Modeling Techniques - Wire frame Modeling - Surface Modeling - 3 D Solid Modeling.

Introduction to Finite Element Analysis - CAD techniques to finite element data preparation- Automatic mesh generation- presentation of results - 3-dimensional shape description and mesh generation- CAD applications of FEM.

CAD applications and exposure to CAD packages: Simple examples of computer aided drafting, design and analysis - Introduction to simple machine elements - Analysis of cross sectional area, centroid & moment of inertia- Kinematics of crank- slider mechanism and

other simple design applications. Introduction to CAD packages like ANSYS, NASTRON, NISA-II.
Introduction to Artificial Intelligence Introduction to Artificial Intelligence - Applications of AI in design and CAD.

Text Books:

1. CAD/CAM- Computer Aided Design & Manufacturing, by M.D.Groover & E.W.Zimmer.
2. Computer Aided Design and Manufacturing, by Dr.Sadhu Singh, Khanna Publishers.

References:

1. Computer Aided Design in Mechanical Engineering, by V.Rama Murthy.
2. Elements of Computer Aided Design & Manufacturing, by Y.C.Pao.
3. Computer Aided Kinetics for Machine Design, by D.L.Ryan.
4. Computer Aided Design and Manufacturing, by C.B.Besant & C.W.K.Lui.
5. Computer-Aided Analysis & Design by S. Ghosal, Prentice Hall of India.
6. CAD/CAM/CIM by Radhakrishna, New age international.

MEC 423 – ENGINEERING ECONOMICS

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week: 5 Th. Ses. : 30 Exam :70

Examination (Theory): 3hrs. Credits : 4

Course Objectives:

To make the students to learn the fundamental concepts of managerial economics, various processes of production, types of business organization. The objective is also to make them to learn processes in price determination in different markets, different costing concepts and basic knowledge of accountancy.

Course Outcomes:

CO-1	Students will understand the basic concepts of managerial economics and business organizations.
CO-2	Students can determine price of products in different markets.
CO-3	Students can perform cost analysis.
CO-4	Students can prepare profit and loss account and balance sheet.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	1		2		2	1	3	3		3	1
CO-2	1	1		1		2	2	3	3		3	1
CO-3	1	1		1		2	1	3	3		3	1
CO-4	1	1		1		2	1	3	3		3	2

Utility, value, wealth, consumption, wants, necessaries, comforts and luxuries. laws of demand, elasticity of demand.

Production, agents of production, laws of returns. Forms of business organization. Single trader, partnership and public limited company.

Price determination in perfect competition, monopoly and imperfect competition. Rent, interest, money, cheques, bills of exchange.

Costing- Cost concepts, Elements of cost, Methods of distribution of overhead costs. Unit costing, Job costing and process costing.

Break- Even analysis, Depreciation methods, Preparation of profit and loss account and balance sheet (Outlines only).

Text Book:

1. Engineering Economics, Vol.1, Tara Chand.

References:

1. A Text book of Economic Theory by Dhingra and Garg.
2. Cost Accounts by Shukla and Grewal.

MEC 424 - PROJECT

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 6 Pr. Ses. : 50 Exam : 50

Credits: 8

Project topic to be decided by the guide/department.

Course Objectives:

To impart students:

Creative/Innovative thinking considering societal issues.
An ability to apply their theoretical knowledge in practical situation.
An ability to work in a team.
An ability to communicate effectively.

Course Outcomes:

The students will be able to develop:

CO_1	An ability to apply knowledge of mathematics, science, and engineering to design and conduct experiments, as well as to analyze and interpret data.
CO-2	An ability to 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.
CO-3	An ability to function on multi-disciplinary teams and engage themselves in life-long learning to be abreast with technological changes.
CO-4	An ability to identify, formulate, and solve engineering problems using latest technological and software tools and also to communicate effectively with the engineering community and society at large.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3								
CO2			3			3	3	3				
CO3									3		3	3
CO4		3			3					3		

MEC 425 - COMPUTER AIDED DESIGN LAB

(Effective from the batch admitted during 2006-2007- Credit System)

Periods/week : 3 Pr. Ses. : 50 Exam : 50
Examination (Practical): 3hrs. Credits: 2

Course Objectives:

- To train students in such way that they can prepare Part model, Assembly of parts and obtaining the final production drawing from the assembly.
- To explain basics concepts of 2D drafting using Auto CAD.
- 3D modeling techniques are explained using solid works.
- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings,
- To explain the Finite Element Analysis using ANSYS.
- To explain FMS using CNC lathe and 6-Axis Robo, and to give them knowledge of CNC programming for various operations on CNC lathe. 6-Axis Robo is used for material handling.

Course Outcomes:

Student will be able to

CO-1	Experiments in the CAD lab will give better knowledge in 2D drafting.
CO-2	Students can prepare 3D Models, Assemblies and Drawings.
CO-3	Students can solve Analysis problems.
CO-4	Students can do the real time industrial projects in the lab using the available softwares.
CO-5	Students will become industry ready.

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	-	1	-	1	-	-	-	-	-	-	-
CO-2	3	-	3	-	3	-	-	-	-	1	-	-
CO-3	3	2	3	3	3	-	2	-	-	1	-	1
CO-4	2	2	2	1	3	-	1	-	1	-	-	1
CO-5	-	-	3	-	2	-	1	1	2	1	1	-

CAD experiments:

1. Initiating the graphics package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.
2. Drawing of primitives (line, arc, circle, ellipse, triangle etc.)
3. Drawing a flange.
4. Drawing a Bushing assembly.

5. Dimensioning the drawing and adding text.
6. Setting the layers and application of the layers.
7. Isometric and orthographic projections.
8. Viewing in Three dimensions.
9. Removal of hidden lines - Shading and rendering.

CAM experiments:

1. Preparation of manual part programming for CNC turning/Milling.
2. Part programming preparation through AutoCAD.
3. APT part programming for 2D - contour.
4. Machining of one job on CNC machine tool.
5. Robot programming through Teaching Box method.
6. Robot programming through computer.