INDIA INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

SYLLABI FOR OPEN ELECTIVE SUBJECTS

AEROSPACE AND APPLIED MECHANICS DEPARTMENT

Finite Element Method (AE721/1)

Contact Period : 3L per week **Full Marks : 100 [Credit – 03]**

Prerequisite: Fundamentals of Mechanics, Calculus, Matrix Algebra, Elementary numerical methods, Adequate familiarity with computer

Sl No.	Article	No. of Classes
1	Overview of Finite Element Method (FEM): Basic concept; Historical background; Engineering applications; Introduction to Displacement, Force and Mixed Formulations.	03
2	Basic procedure : Discretization – Basic element shapes, Node numbering scheme; Interpolation model - Order of polynomial, Generalized and Natural co-ordinates, Convergence requirement, Patch test; Illustrations.	08
3	Derivation of Characteristic Matrices : Introduction to Direct approach, Variational approach (Raleigh-Ritz) and Weighted Residual Approach (Collocation, Least Square, Galerkin); Derivation of Finite Element equations using Variational and Weighted Residual Approach; Introduction to Strong and Weak Form formulation; Illustrations.	10
4	Assembly and Derivation of System Equations : Co-ordinate Transformation; Assemblage; Substitution of Boundary Conditions.	06
5	Numerical Solution of FEM Equations : Introduction to Band solver and Skyline technique; Applications to Equilibrium and Eigen value problems	09
6	Concluding Remarks: Comparison with other established numerical methods; Introduction to popular FEM packages.	04
	Total	**40**

Books recommended:

- "The Finite Element Method" by S. S. Rao
- "An Introduction to The Finite Element Method" by J. N. Reddy
- "Fundamentals of Finite Element Analysis" by D. V. Hutton

Advanced Vibration (AE721/2)

Contact Period : 3L per week **Full Marks : 100 [Credit – 03]**

Sl No.	Article	No. of Classes
1	1. **INTRODUCTION**: Introduction to vibration in engineering systems; Lumped parameter systems.	03
2	1. **VIBRATION OF ONE DIMENSIONAL CONTINUOUS SYSTEMS**: Equations of motion Newtonian approach; Variational formulation. Free and forced vibrations. Modal analysis. Special topics and application.	17
3	1. **NONLINEAR VIBRATIONS**: Phase plane; Equilibrium solutions; Limit cycles; Linear stability analysis; Averaging and perturbation methods. Chaos.	20
	Total	**40**

Books recommended:

P. Srinivasan, *Nonlinear Mechanical Vibrations,* New Age International, New Delhi

S. S. Rao, *Mechanical Vibrations,*Pearson Education, New Delhi

W. T. Thompson, *Theory of Vibration with* Applications, George Allen

Numerical Methods and Computational Tools (AE531/1)

Contact Period : 3L per week **Full Marks : 100 [Credit – 03]**
Prerequisite : Elementary knowledge of mathematics

Sl.	Article	No. of classes
1.	**Solution for linear systems of equation:** Elementary definitions related to matrix operation – consistency of the system – direct methods of solution (inversion, Gauss method, Gauss-Jordan method, LU decomposition, Cholesky decomposition) – ill conditioned system – iterative methods and convergence study (Gauss-Siedel method, Jacobi method) – application to physical systems and development of codes using s/w tools. Solution for nonlinear system of equations: Newton's vector method	12
2.	**Eigen values and eigen vectors**: Characteristic polynomials – direct power method – Jacobi method – application to physical systems and development of codes using using s/w tools.	04
3.	**Numerical differentiation and integration**: FD approximation and error analysis – trapezoidal method and Simpson's method – adaptive quadrature	04
4.	**Solution to ODE:** Euler's method – 2^{nd} & 4^{th} Runge-Kutta method – Adams-Bashforth-Moulton predictor corrector method – error estimation – application to physical systems and development of codes using s/w tools.	05
5.	**Solution to PDE:** Equation classification – solution to equation (central difference method, Jacobi method, iterative method, Gauss-Siedel method, SOR method) – application to physical systems and development of codes using s/w tools.	04
6.	**Finite element method:** Definition – element characteristic matrix (direct, variation, weighted residual) – natural and geometric boundary condition – Rayleigh-Ritz approach – element assembly – matrix sparsity and solution – shape function and degree of continuity – natural coordinates – Gauss quadrature – isoparametric formulation & different elements – briefing on discretisation error	15
Total		44

Books recommended:

1. Numerical methods using MATLAB, Mathews & Fink, PHI
2. Introductory methods of numerical analysis, Sastry, PHI
3. Concepts and applications of finite element analysis, Cook et al., John Wiley & Sons

Modelling and Simulation (CE 731/1)

Weekly Contact: 3-0-0 Pre-requisite: CE-501 & 601 Full Marks: 100 Credits: 3

Sl. No.	Topic	No. of hours / lectures
1	Introduction to concept of System, its boundary, components and interaction, classifications	4
2	System Modelling: introduction, need and classification, concept of mathematical modelling of physical systems and phenomena with examples, concept of model building	8
3	Differential Equations for modelling of engineering system and phenomena, introduction to computational approach of solution	8
4	Concept of Simulation of System, Stochastic Simulation	6
5	Curve Fitting, Metamodeling Approaches	6
6	Introduction to Optimization concept, Model Updating	4
Total		**36**

Suggested Reading:

1. Modelling and Simulation of System using MATLAB and Simulink, DK Chaturvedi, CRC Press.
2. Principles of Mathematical Modelling, Clive L. Dym,Elsevier Academic Press.
3. Simulation and The Monte Carlo Method, Reuven Y. Rubinstein, Dirk P. Kroese, Wiley-Interscience Press.

Principles of Slope Stability Analysis [CE 731/2]

Weekly contact 3-0-0 (L -T -S) Prerequisite: CE 603 Full Marks: 100 Credit: 3

Sl. No.	Topic	Contact hours
1	Introduction, natural and man-made slopes, causes of slope failures	2
2	Infinite slopes – Definition, mode of failure, limit equilibrium, analysis of cohesionless and cohesive slopes with and without seepage occurring	3
3	Finite slopes – Modes of failure, slip surfaces of specific shapes, general slip surfaces	2
4	Analysis of finite slopes based on limit equilibrium principles - Methods of Slices – Unknowns and Equations,	2
5	Ordinary method of slices, Bishop simplified method, Spencer method for circular slip surfaces	5
6	Methods of slices valid for general slip surfaces – Spencer method	3
7	Stability Analyses for Critical stages in the life of an earth dam	4
8	Pseudo-static approach of slope stability analysis under seismic loading	3
9	Determination of Critical slip surfaces using optimization techniques	4
10	Use of Slope Stability Charts – Taylor's charts, Bishop and Morgenstern Charts	3
11	Stability Analysis of Geotextile Reinforced Soil Slopes based on Limit Equilibrium Principles.	5
	Total	36

Suggested Readings

1. Fundamentals of Soil Mechanics—D.W. Taylor
2. Soil Mechanics – T.W. Lambe and R.V. Whitman
3. Soil Mechanics – R. F. Craig
4. Geotechnical Earthquake Engineering – S.L. Kramer
5. Geotechnical Slope Analysis – R. Chowdhury, P. Flentje and G. Bhattacharya
6. Designing with Geosynthetics – R.M. Koerner

Environmental Management (CE – 731/4)

Weekly contact 3-0-0 (L -T -S) **Prerequisite: None** **Full Marks: 100**
Credit: 3

Sl. No.	Module Name & Topics	No. of Lectures
1.	**Industrial activity and the environment** – air pollution, solid waste, hazardous waste, water pollution, energy usage, resource depletion	4
2.	**Environmental Regulations and International Protocols**	4
3.	**Life cycle assessment** – stages in product LCA, LCA methodology, application of LCA	4
4.	**Environmental Impact Assessment** – purpose of EIA, steps in EIA, Environmental impact statement, impact indicators	4
5.	**Environmental Audit** – types of environmental audit, EA methodology	4
6.	**Pollution prevention planning and Improved manufacturing operations**	4
7.	**Design for the environment** – benefits, ED for manufactured products, ED for buildings, ED for developmental planning	4
8.	**Environmental Management System** – core elements of EMS, documentation for EMS, implementation of EMS	4
9.	**Toward a sustainable society** – what is sustainability, hurdles to sustainability, a framework for sustainability,achieving sustainable development	4
	Total =	36

Suggested readings:

- Bishop, P.L. Pollution Prevention : Fundamentals and Practice. McGraw-Hill. ISBN 0-07-366147-3
- Kulkarni, V. and Ramachandra, T.V. Environmental Management. TERI Press. ISBN 978-81-7993-184-4

Introduction to Geographic Information System (CE 531/1)

Weekly contact: 2 - 1– 0 Prerequisite: NIL Full Marks: 100 [Credit: 3]

Sl. No.	Module Name and Topics	No. of Lectures
1.	**Introduction**: Information System, Geographic Information System, GIS database, GIS data type, GIS data models	05
2.	**Raster and Vector data**: Introduction about raster and vector data, Raster Encoding methods, Shape of the earth, Transformation, Vectorization	06
3.	**Attribute database and overlay**: Attribute data, Relations, GIS functionality, Spatial Query, Vector data query, Overlay, Buffer, Network theory	08
4.	**GIS analysis:** Thematic maps, Spatial statistics, Model building	06
5.	**Remote Sensing and Digital Image Processing**: Remote Sensing, Use of Electromagnetic spectrum in remote sensing, Process of remote sensing, Image Processing, Applications of Remote Sensing	07
6.	**Applications of GIS in various fields of Engineering**	04
	TOTAL:	36

Suggested Readings:

- Pandey, J and Pathak, D,"Geographic Information System", The Energy and Resources Institute Press.
- Lo, C.P. and Yeung, Albert, "Concepts and Techniques of Geographic Information Systems", Prentice Hall.

Climate Change Impact Analysis (CE 504/2)

Weekly contact: 2 - 1– 0 Prerequisite: CE 1201 Full Marks: 100 Credit: 3

Sl. No.	Module Name and Topics	No. of Lectures

1.	General overview of climate change problem and impacts on societies and ecosystems, Overview of different aspects involved in climate change impact investigation	
2.	Historical trend testing, separation of trends from natural variability	
3.	Introduction to climate models, greenhouse gas scenarios and climate model simulations, On the time and space scale gaps between climate model outputs and impact analysis needs, Access and processing of climate model outputs from public databases	
	On the needs for statistical downscaling and bias correction: introduction on methods, Methods for statistical downscaling and bias correction: Delta change method, Weather typing/ Resampling, Rainfall generator method, Application of delta change and weather generator method for hydrological impact analysis of climate change	
	Climate scenario development, Methods for impact analysis of climate change, Climate adaptation needs & Decision making under uncertainty	
	TOTAL:	**36**

Suggested Readings:

- P. P. Mujumdar and D. Nagesh Kumar. (2012) Floods in a Changing Climate: Hydrologic Modeling,
- Mondal, A. and P. P. Mujumdar (2015), Hydrologic Extremes under Climate Change: Non-stationarity and Uncertainty, In. Sustainable Water Resources Planning and Management under Climate Change,.
- Willems, P., Olsson, J., Arnbjerg-Nielsen, K., Beecham, S., Pathirana, A., Bülow Gregersen, I., Madsen, H., Nguyen, V-T-V. (2012), 'Impacts of climate change on rainfall extremes and urban drainage'.

Uncertainty Quantification in Engineering (CE 531/3)

Weekly contact: 2 - 1– 0 Prerequisite: NIL Full Marks: 100 Credit: 3

Sl. No.	Module Name and Topics	No. of Lectures
1.	**Introduction:** Why uncertainty Quantification? Sources and types of Uncertainty Verification and Validation, Error vs Uncertainty Sensitivity Analysis vs. Uncertainty Quantification	6 hours
2.	**Uncertainty Quantification :** Data Analysis: Probabilistic and Possibilistic descriptions	8 hours
3.	**Uncertainty Propagation:** Probabilistic Uncertainty Propagation: Moment based perturbation approach of uncertainty quantification Brute Force Monte Carlo Simulation and advanced simulation methods Introduction to possibilistic approach of uncertainty analysis Introduction Bayesian method of Uncertainty Analysis	**4** **8** **6** **4**
	TOTAL:	**36**

Suggested Readings:

- T. T. Soong, Fundamentals of probability and statistics for engineers, John Wiley & Sons Ltd
- H-S. Ang, W. H. Tang Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering, John Wiley & Sons Ltd
- Achintya Haldar and Sankaran Mahadevan, Probability, Reliability, and Statistical Methods in Engineering Design John Wiley & Sons Ltd

Database Management Techniques (CS 531/1)

Weekly contact: 3-0-0 Credit : 3 Full Marks :100

Sl. No.	Module Name and Topics	No. of Hours
1	Database(DB), Database Management Systems (DBMS), Database Systems versus File Systems, DB users, DB Administrators, 3-Level Architecture of DBMS, Data Independence, Integrity, Consistency.	3
2	Data Models (ER Model): Constraints, Cardinality Constraints, Weak-Entity Types, Subclasses and Inheritance, Specialization and Generalization, Case Studies on E-R model	6
3	Data Model (Relational Model):ER to Relational mapping, Relational Algebra, Query language SQL, Views, Integrity constraints, Specifying indexes, Embedded SQL.	8
4	Normalization and its importance, Functional Dependencies, 1NF to BCNF, Lossless decomposition, Dependency Preservation, Canonical cover of a Functional Dependency Set etc.	8
5	Issues in DBMS implementation: Security, Recovery and concurrency control, transaction management	8
6	Data Ananysis: Data preprocessing, Clustering, Classification, case study	7
Total		**40**

Object Oriented Programming Paradigm (CS531/2)

Weekly contact: 3-0-0 Credit : 3 Full Marks :100

Sl. No	Module Name and Topics	No. of Hours
1	Introduction: Evolution of Object Oriented (OO) Methodology, Basic Concepts of OO Approach, Comparison of Object Oriented and Procedure Oriented Approaches , Benefits of OOPs	2
2	Classes and objects: encapsulation, create objects, constructors, overloading constructors, Argument passing, returning objects etc.	3
3	Inheritance and Polymorphism: Multiple inheritance, Multilevel Inheritance, hierarchical inheritance, base and derived classes, Access Control, virtual base class, Operator and function Overloading, Abstract Classes, Runtime Polymorphism	14
4.	Exceptions Handling: Exception handling using try-catch and finally clause, type of exceptions, throwing exceptions etc.	3
5	Introduction to UML: Use case diagram, Class diagram, object diagram, activity diagram, interaction diagram.	8
6	Case studies: Object Oriented Design, analysis and implementation of any real life problem	8
Total		**38**

Management Information Systems (CS731/1)

Weekly contact: 3-0-0 Credit : 3 Full Marks :100

Sl. No.	Module Name and Topics	No. of Hours
1	Systems Concept – Characteristics, Types, Boundaries, Subsystems	2
2	Organizational system, Information System	2
3	Systems Approach to Management, Management Information Systems (MIS) and its Role in Organization	4
4	Types and Functions of MIS, MIS tools	4
5	Feedback and Control in Information Systems, Feed-Forward Control	3
6	Information Quality and Information Value Chain	3
7	Models used in MIS such as CSF, Strategic Planning, Management Control Model	3
8	Basic Design Concepts for MIS oriented applications	6
9	Decision making Process: Structured and Unstructured, Concepts of DSS, ES, KBS, etc.	6
10	Socio Technical Aspects of MIS	3
Total		**36**

Soft Computing (CS731/2)

Weekly contact: 3-0-0 Credit : 3 Full Marks :100

Sl. No.	Module Name and topics	No. of Hours
1	**Overview:** Motivation, Computational Intelligence	1
2	**Fuzzy Sets and Systems:** Crisp set and Fuzzy set, Membership functions, Operations on fuzzy sets, Properties of fuzzy sets, Fuzzy Relations, Fuzzy Measures, Fuzzy Arithmetic, Fuzzy extension principle, Approximate Reasoning, Fuzzy implication functions, Fuzzy Inference Systems, Type-2 fuzzy sets, Applications.	8
3	**Artificial Neural Networks:** Fundamental concepts of neural networks, Basic models and learning rules, Supervised learning, Perceptron Learning Rules, Back propagation network, Unsupervised learning, Hebbian learning, Self-Organizing feature map, Radial Basis function network, Recurrent neural network, current topics: Deep Learning, Applications.	9
4	**Optimization methods** *Genetic Algorithms*: Basic concepts of genetic algorithms, encoding, Genetic Operators, Fitness function, genetic modeling, Applications *Particle Swarm Optimization:* Basic Concepts, Local Best, Global Best, Velocity Updation, Position Updation, Variant of PSO, Applications Differential Evaluation: Basic Concept, Initialization of vectors, Target Vector, Donor Vector, Selection, Mutation, Crossover, Control Parameters, Applications Ant colony optimization and current topics	8
5	**Rough Set Theory:** Decision Systems, Indiscernibility Relation, Inconsistency, Lower and Upper Approximation, Rough Set, Attribute dependency, Attribute Reduction, Discernibility matrix, Reduct and Core, Applications of Rough Set Theory:- dimensionality Reduction, Feature Selection, Classifier.	5
6	**Hybrid Systems:** Integration of Artificial neural networks, Fuzzy logic, Rough set Theory and Evolutionary Algorithms, Applications	4
	Total	**35**

ELECTRICAL ENGINEERING

Electricity Conservation and Environment Management (EE-731/1)

Sl. No.	Module Name and topics	No. of Hours
1	**Introduction**: Concept of energy, energy scenario, conversion of energy to electrical form, energy and society, review of conventional and non-conventional energy sources and their potential, electrical energy generation, distribution and utilization pattern.	8
2	**Pollution and Control:** Type of atmospheric pollution (air, water, noise, radiation, etc). Industry wise pollutants, pollution from conventional power generating stations/ sources, & automobile, pollution from nuclear power and uses of PV cells	5
3	**Environmental Analysis:** Environmental change, ecosystem, resource depletion, effects, Land use - Government action and Environmental Organization	5
4	**Electrical Energy utilization:** Concept of energy efficiency of electrical appliances. Installation, repair and general maintenance of appliances for efficiency improvement.	3
5	**Energy Management:** Load dispatch mechanism and energy management at regional and national level, load scheduling, SCADA and EMS.	8
6	**Conservation Methods:** Institutional role of energy conservation, related case studies. In transmission and distribution, electric power drives, traction, lighting, heating, refrigeration and air conditioning, agricultural appliances.	4
	Energy Conservation & Environment Protection policy: General awareness energy police and planning economics of energy management, Kyoto protocol, CDM, Carbon Capture and related topics	
	Total	**35**

Illumination Engineering (EE-731/2)

Contact Period: 3-0-0 Credit : 3 Full Marks: 100

Sl. No.	Module Name and topics	No. of Hours
1	**Sources of light** : Day light, artificial light source; energy radiation, visible spectrum of radiation, black body radiation and full radiator.	[04]
2	**Incandescence**: Dependence of light output on temperature. Theory of gas discharge and production of light.	[03]
3	**Perception of light and colour:** optical system of human eye as visual processor, Reflection, refraction and other behaviours of light.	[04]
4	**Measurement of light** – radiometric and photometric quantities and their units of measurement. Standardization, measurement of light distribution, direct & diffused reflection, fundamental concept of colourimeters and measurement of colour.	[06]
5	**Types of lamps** : GLS Tungsten – halogen, Discharge, low pressure sodium vapour, high pressure sodium mercury vapour, fluorescent, Metal – halide, IR and UV lamps, their construction, filament material, theory of operation, life, characteristics and application Xenon Lamps, LED lamps, Fibre Optic and Laser Lighting.	[09]
6	**Luminaires**: Basic lighting design consideration and lighting parameters for exterior lighting, interior lighting and day lighting. Case Studies.	[07]
7	**Energy conservation** in lighting.	[03]
	Total	**36**

Elements of Control Systems (EE531/1)

Weekly Contact: 3-0-0 **[Credit 3] Full Marks 100**

Sl. No.	Module Name and topics	No. of Hours
1	**Introduction:** Need for control, elementary control system (block diagram), open and closed loop control systems – basic concepts	2
2	**Mathematical Models of Physical Systems:** Need for mathematical modelling, differential equation-based mathematical models, transfer-function based modelling – concepts of poles and zeros, types & order of systems etc, block diagram algebra and block diagram reduction techniques	5
3	**Time Response Analysis:** Introduction; Standard test signals – Impulse, Step and Ramp Inputs; Time-response of first and second order systems; Steady state errors and error-constants; Design specifications for a standard second order system; performance-indices	5
4	**Concepts of Stability and Algebraic Criteria:** Concept of stability – ZI and BIBO stability, necessary conditions for stability; Routh Stability Criterion; Relative stability analysis	4
5	**The Root Locus Technique:** Basic concept; Construction of Root Loci; Root Contours – Examples	5
6	**Frequency Response Analysis:** Introduction; Correlation between time and frequency response; Polar Plots; Bode-Plots – basic construction rules – Examples; Experimental determination of transfer function	6
7.	**Closed Loop Controllers:** Closed loop control using: (a) P, P-I and P-I-D controllers, (b) Lead, Lag and Lead-Lag Compensators – Examples	6
8.	**Practical Control Systems:** Components of a practical control system – sensors, controllers, actuators – Examples; Micro-computer based control systems – a brief introduction; Few case studies	3
Total		**36**

INFORMATION TECHNLOGY

Multimedia Systems (IT 531/1)

Weekly contact period: 3 – 0 – 0 Full Marks: 100

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction to Multimedia , Elements of Multimedia, Properties of multimedia system, Categories, Features, Application, Convergence of Multimedia System	2
2.	**Image:** Raster and Vector, Types of image, Digital image representation, Color model, Image negation, change of dynamic range, Histogram, File system (TIFF, BMP, PCX, GIF etc.), System Architecture **Compression:** Advantages, disadvantages, Spatial and temporal redundancies, Lossless and Lossy compression, DPCM, Lampel-Ziv, Huffman coding, Arithmetic coding, GIF, JPEG.	8
3.	Audio: Sound wave, Physical characteristic, Musical note, Components of Audio System, Microphone: moving coil, condenser, Amplifier: class A Class B, Speaker, Synthesizer, MIDI. Sound card, Digital Audio processing.	6
4.	Video: Luminance & Chrominance, Luma and Chroma, Chroma Sub-sampling, Television Systems PAL, NTSC, Video Nomenclature HDTV, EDTV, Video Quality and Performance Measurements, Digital Video Processing Video capture, Video processing AVO/AVI file formats.	4
5.	MPEG standard Hypertext, hyper media. Virtual Reality and multimedia.	2
7.	Animation: Key frame and Tweening, Cell Animation, Rotoscoping, Stop-Motion Animation, Motion Cycling, Computer Based Animation, Path based animation, Client pull and server push,	2
7	Multimedia devices- Display devices, Optical Devices, CCD, Camera, DVD, Scanners	2
8	Multimedia Database-Image Representation, Segmentation, Similarity based retrieval, Image retrieval by color, Shape & texture, indexing –K-d-tree, R-tree, Video Content, Quad tree, Querying, Video Segmentation, Indexing.	6
	Total:	32

References:

1) R. Steinmetz, K. Nahrstedt, "Multimedia Systems", Springer Science & Business Media.
2) J.F.K, Buford, Multimedia Systems, ACM Press.
3) Sloane, Multimedia Communication, McGraw Hill.
4) Boyle, Design for Multimedia Learning Prentice Hall.
5) B Prabhakaran, Kluwer, Multimedia Database Management Systems, Springer.

Computational Geometry (IT 721/1)

Prerequisite(s): Concepts of Computer Graphics, Data Structures and Algorithms

Weekly contact: 3-0-0 **F.M.: 100**

Sl. No.	Module Name and Topics	No. of Classes
1.	Computational Geometry: Introduction, degeneracy and robustness, Application domains	3
2.	Orthogonal range searching (in brief): kd-tree, range tree, Lower Bounds on Algebraic tree model and Geometric data structures (DCEL)	6
3.	The Maximal Points Problem (closest pair and farthest pair), Geometric searching, Slab method, Range searching	3
4.	Point Location and Triangulation, triangulating monotone polygon	4
5.	Convex Hull, Different Paradigms, Voronoi Diagram and Delaunay Triangulation, and Quickhull	6
6.	Line segment intersection, Linear programming, Intersection of convex polygons, planes	5
7.	Clustering Point Sets using Quadtrees and Applications	2
8.	Introduction using Basic Visibility Problems, visibility graph and edge and applications to robot path planning	3
9.	Shape Analysis and Shape Comparison	3
10	Intersection and union of rectangles and largest empty space recognition	2
11.	Some applications and case studies	3
	Total	40

References:

1. Computational Geometry: Algorithms and Applications, Authors: de Berg, M., Cheong, O., van Kreveld, M., Overmars, M.

2. Computational Geometry - An Introduction, Authors: Preparata, Franco P., Shamos, Michae

3. Discrete and Computational Geometry, Satyan L. Devadoss& Joseph O'Rourke

MECHANICAL ENGINEERING

Power Plant Engineering (ME-731/1)

Contact Period: 3-0-0 **Credit: 3** **Full Marks -100**

Serial No.	Topics	No. of Lectures
1.	Introduction to Thermal Power Plants, Site selection and Plant layout, Material estimation for thermal power plant, Basic thermodynamic cycles for thermal power plants	03
2.	Steam power plant: heat losses and heat balance, efficiency and heat rates	03
3.	Power station boilers: subcritical and supercritical steam generation, circulation and draught systems, superheaters, coal mills, air heaters,	04
4.	Condenser and cooling tower, Water treatment, coal and ash handling systems, dust collecting devices	05
5.	Operation and control of steam power plant: Drum level, steam temperature, air flow and air pressure, combustion, deaerator and hot well level	05
6.	Combined cycles: series and parallel cycles, Binary vapour cycle. Integrated Gasification Combined cycle. Combined heat and power.	03
	Emission from thermal power plants and its control, other environmental aspects of thermal power generation	03
7.	Fluctuating loads in power plants and terminologies involved in connection to fluctuating load, Economic analysis of power plants; payback period, cost of electricity and tariffs	04
8.	Hydel power: Hydro electric power plant. Site selection and plant layout. Run off and measurement, Hydrograph, Flow duration curve and mass curve. Storage type power plant, pump storage plant, Mini and Micro Hydel plants. Components of hydel plants, Dam-Types, Spillways and hydraulic turbines.	05
9.	Nuclear power: Nuclear reactions, Types of reactors: PWR, BWR, PHWR, Liquid metal cooled reactor, Fast Breeder Reactor, safety and associated environmental issues	04
Total		**39**

Text Books

Power Plant Engineering, P.K.Nag.

Power Plant Engineering, V.M. Domkundwar.

Reference Books

Power Plant Technology, W. Culp

Power Plant Technology, M. El. Wakil.

Power Plant Technology, Black & Vetch

COMPUTATIONAL FLUID DYNAMICS (ME 731/2)

Contact Period: 3-0-0 **Credit – 3** **Full Marks : 100**

Sl No.	Topics	No. of lectureS
1	**Introduction:** Computational Fluid Dynamics (CFD) and its development, Applications of CFD, Advantages and limitations of CFD, Comparison with analytical method and experimental studies.	02
2	**Governing Equations in CFD:** Conservation of mass, Chemical species, Energy equation, Momentum equation, Turbulence - Kinetic energy equation, Boundary conditions.	04
3	**Discretization:** Structure of discretization equation, Different methods of getting discretized equations, Taylor series formulation, Variational formulation, Method of weighted residuals, Control volume formulation.	04
4	**Finite Difference Method:** Application in 1-D and 2-D heat conduction problems, Solution of simultaneous linear algebraic equations, Thomas algorithm or TDMA (Tri - Diagonal Matrix Algorithm), Explicit, Crank - Nicolson and fully implicit schemes for unsteady conduction problem.	08
5	**Applications of Finite Difference Method in Convection and Diffusion problems:** Steady one dimensional problem, Different finite difference schemes like central difference, upwind scheme, Exponential scheme, Hybrid scheme, Power law scheme, Comparison of different schemes, Discretization for 2-D and 3-D problems.	12
6	**Flow Field and Temperature Distribution Calculations:** Grid structure, Staggered and non-staggered grid arrangement, SIMPLE algorithm.	06
7	Code development in CFD and its validation, Brief knowledge about the available commercial CFD codes.	06
	Total	**42**

Text Books :

1. Numerical Heat Transfer and Fluid Flow by Suhas V. Patankar, Hemisphere publishing corporation, 1980.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method by H. K. Versteeg and W. Malalasekera, Pearson Educational Limited, Second Edition, 2007.

Reference Books :

1. Computational Fluid Dynamics: The Basic with Applications by John D. Anderson, Jr. - McGraw Hill, Inc., 1995.
2. Computational Fluid Mechanics and Heat Transfer, Third Edition by By Richard H. Pletcher, John C. Tannehill, Dale Anderson, CRC Press, 2013.

SOLAR ENERGY AND ITS APPLICATIONS (ME - 531/1)

Weekly Contact Period: 3-0-0 **Full Marks: 100 (Credit: 3)**

Sl. No.	Topics	No. of periods
1.	Solar radiation: Introduction, Sun as the source of radiation, Solar constant, Spectral distribution of extraterrestrial radiation, Variation of extraterrestrial radiation.	06
2.	Classification of solar radiation: Beam solar radiation, Diffuse solar radiation, Global solar radiation.	02
3.	Solar radiation geometry: Latitude of location, Declination, Hour angle, Slope of surface, Altitude angle, Zenith angle, Solar azimuth angle, Local solar time, Equation of time.	05
4.	Estimation of solar radiation: Average daily global radiation, Average daily diffuse radiation, Hourly global radiation, Hourly diffuse radiation, Angle of incidence on horizontal surface, Angle of incidence on inclined surface, Computation of solar radiation on tilted surface.	08
5.	Measurements of solar radiation: Pyranometer, Pyrheliometer, Sunshine recorder, Spectral measurements, Calibration and standardization of measuring instruments.	05
6.	Solar thermal applications: Basic overview of solar collectors, Solar water heating, Solar cooking, Solar desalination, Solar drying of food products, Solar energy for industrial process heat, Solar active heating of buildings, Solar passive heating of buildings, Solar greenhouses, Solar refrigeration.	08
7.	Solar photovoltaic: Fundamentals of photovoltaic conversion, Efficiency of solar cells, Solar modules and array, Balance of system (BOS), Standalone system, Grid independent system, Grid interactive system, Photovoltaic applications.	06
Total		**40**

Text Books:

1. Solar Energy Fundamentals and Applications by H. P. Garg and J. Prakash, Tata Mc Graw-Hill Publishing Company Limited.
2. Solar Energy Fundamentals, Design, Modelling and Applications by G. N. Tiwari, Narosa Publishing House.

Reference Books:

1. Solar Energy: Principles of Thermal Collection and Storage by S. P. Sukhatme and J.K.Nayak, Tata Mc Graw-Hill Publishing Company Limited.
2. Solar Engineering of Thermal Processes by John A. Duffie and William A. Beckman, John Wiley and Sons, Inc.

INDUSTRIAL MANAGEMENT (ME-531/2)

Weekly Contact Period: 3-0-0 **Full Marks: 100 (Credit: 3)**

Sl. No.	Topics	No. of periods
1.	Principles of Management: Unity of direction, Unity of command, Authority and responsibility, Span of control, Delegation of authority, Motivation, Leadership, Policy, Committee.	03
2.	Functions of a Manager: Planning, Organizing, Staffing, Controlling, Direction, Innovation and representation.	03
3.	Organization Structure.	03
4.	Plant location, Plant layout and line balancing.	03
5.	Inventory Control: EOQ, ABC analysis, LIFO, FIFO.	04
6.	Production planning and control: Bar chart, Gantt chart, Sales forecasting.	04
7.	Incentives scheme, Merit rating and job evaluation.	04
8.	Statistical quality control: A brief introduction on SQC, Definition of quality, Various tools and techniques used in SQC, OC curve, Sampling theory, Process control charts and their applications.	06
9.	Work study and work measurement, Principles of motion economy, SIMO chart, Man machine chart.	04
10.	Network analysis.	03
11.	Maintenance policy and reliability engineering.	03
12.	Industrial law: Safety rules, Industrial dispute act, factory act, strikes.	02
Total		**42**

Text Books:

1. Industrial Engineering and Management by O. P. Khanna, Dhanpat Rai Publications.
2. Production Systems: Planning, Analysis, and Control by James L. Riggs, John Willey and Sons.

Reference Books:

1. Factory and Production Management by K.G.Lockyer, The ELBS and Pitman Publishing.
2. Production and Operations Management by S.N.Chary, Tata McGraw – Hill, New Delhi
3. Statistical Quality Control by Grant and Leavenworth, 7th Edition, Tata Mcgraw Hill

Metal Forming (ME - 703/3)

Contact Period : 3-0-0 **CREDIT: 3** **Full Marks : 100**

Sl No.	Topics	No. of lecture periods
1.	Elastic and plastic stress-strain relation and deformation behaviour, Fundamentals of plasticity, yield and flow, instability and anisotropy	05
2.	Modelling techniques for metal forming processes	04
3.	Hot, warm and cold working, recrystallization, grain structure and lubrication	02
4.	Forging. (process details and power calculation)	05
5.	Wire and tube drawing, deep drawing (process details and power calculation)	05
6.	Rolling (terminology, types, process control and power calculation)	07
7.	Extrusion. (process details and power calculation)	06
8.	Sheet metal forming process : Process terminology, types, Tool and dies, power estimation and springback calculation	06
	Total	**40**

Text Book :

1. Mechanical Metallurgy : G.E.Dieter, McGraw Hill Company

Reference Books :

1. Manufacturing Processes for Engineering Materials by S.Kalpakjain & S.R. Schmid, Pearson (Delhi) Publication.
2. Modelling techniques for metal forming processes by G.K. Lal, P.M.Dixit, N.Venkata Reddy. Narosa Publication
3. Principles of Industrial Metalworking processes.- G.W. Rowe, CBS Publishers, N.Delhi

Operations Research (MA-731/1)

Weekly contact periods: 2-1-0 Full Marks: 100 Credit – 3

Sl. No.	Module and Topics	No. of Lecturer Classes
1.	**Duality:** Concept of duality- Formulation of primal- dual problems, Rules for forming dual problem from a primal problem in l.p.p., Fundamental properties of duality, Duality and simplex method.	8
2.	**Transportation Problem:** Introduction, Mathematical model of transportation problem, Finding initial basic feasible solution, Optimality test unbalanced transportation problem.	7
3.	**Assignment Problem:** Introduction, Mathematical formulation of assignment problem, Solution of an assignment problem, Unbalanced assignment problem, The travelling salesman problem.	6
4.	**Integer Programming:** Introduction, Gomory's cutting plane method for solution of integer programming problem, Branch and bound method for solution integer programming problem.	5
5.	**Sensitivity Analysis:** Introduction, Changes in the cost parameters, Changes in the requirement parameters, Addition and deletion of a new variable, Addition and deletion of a new constraints.	8
6.	**Non-linear Programming:** Introduction, Lagranges method for solution of a non-linear programming problem, Non-linear programming with equality and inequality constraints, Khun-Tucker conditions, Solutions using KTP conditions.	8
	First half: Sl. No. 1,2,3 Second half: Sl. No.4,5,6	42

Suggested Reading: (1) Operations Research – H. Taha (2) Operations Research – R. Panneerselvam (3) Operations Research – P. K. Gupta (S. Chand)

Classical and Quantum Information Theory (MA-731/2)

Weekly contact periods: 2-1-0 Full Marks: 100 Credit – 3

Sl. No.	Module and Topics	No. of Lecturer Classes
1.	**Classical Information Theory:** Probability spaces, Characterization of information by Shannon's entropy. Basic properties of entropy, entropy rate, conditional entropy and information, Relative entropy.	8
2.	**Types of Channels:** Information channels, stationery properties of channels. Data processing inequality.	5
3.	**Mathematical Background of Quantum Information:** The description of Ket vectors. Operator theory in Ket space. Quantum evolution operator, Quantum measurement.	8
4.	**Classical-bit or Qubit:** Definition of qubits as units of quantum information. Comparison of qubits with classical bits.	4
5.	**Entanglement:** Quantum entanglement- definition and elementary properties. Bell's states and GHZ –states as entangled states.	5
6.	**Measurement :** Measures of quantum entanglement through quantum entropy. Uses of entangled states as quantum information resources. Maximally entangled states. The quantum no-cloning theorem. The quantum no-deletion principle.	8
7.	**Teleportation:** Transmission of quantum information. The teleportation protocols for single qubits and multi-qubits.	4
	First half: Sl. No. 1,2,3,4 Second half: Sl. No.5,6,7	42

Suggested Reading:

(1) Quantum Computation and Quantum Information – Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press (2010).
(2) A Text Book of Quantum Mechanics – P. M. Mathews and K. Venkatesan, McGraw Hill Education (India) Private Limited (1978).
(3) Information Theory, Inference and Learning Algorithm- David J. C. Mackay, Cambridge University Press (2003).

Information and Fuzzy Systems (MA-531/1)

Weekly contact periods: 2-1-0 Full Marks: 100 Credit – 3

Sl. No.	Module and Topics	No. of Lecturer Classes
1.	**Information theory:** Introduction - Axioms of Information - Mathematical expression of information - Units of information	4
2.	**Measure of information:** Entropy, properties of entropy, Joint and conditional entropy, Weighted entropy ,Some results of information	6
3.	**Types of channel:** Channel, Axioms of uncertainty and its mathematical derivation	8
4.	**Measure of uncertainty for continuous variables:** uncertainty for continuous variables, Properties, Different problems and related applications	8
5.	**Fuzzy set theory:** Basic fuzzy set theory and their properties	4
6.	**Fuzzy number:** Triangular fuzzy number, Trapezoidal fuzzy number and their arithmetic operations	6
7.	**Fuzzy decision making:** Decision making process and fuzzy decision making process, some real life applications, basic fuzzy optimization	6
	First half: Sl. No. 1,2,3,4 Second half: Sl. No. 5,6,7	42

Suggested Reading: (1)Information Theory – Karameshu (2) Information Theory and Applications – Giashu (3) Fuzzy Set Theory and its Applications – H – J Zimmermann (4) An Introduction to Fuzzy Logic and Fuzzy Sets – J. Buckley