SCHEME & SYLLABI

OF

M.TECH MECHANICAL ENGINEERING DESIGN

(Choice Based Credit Scheme)

w.e.f. 2018 -2019

(as per AICTE model scheme)

DEPARTMENT OF MECHANICAL ENGINEERING

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD

Scheme and Syllabus approved in 2nd BOS (PG) held on dated 14.06.2018; Item No. BOS (PG)/02/03

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD

M.TECH (MECHANICAL ENGINEERING DESIGN)

Curriculum Structure – Semester-wise

First Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
MMD-101A	Advanced Stress Analysis	3-0-0	3	25	75	Core-I
MMD-102A	Advanced Vibrations and Acoustics	3-0-0	3	25	75	Core-II
MMD-103A	Discipline specific Elective-I	3-0-0	3	25	75	Programme Elective-I
MMD-104A	Discipline specific Elective-II	3-0-0	3	25	75	Programme Elective-II
MMD-105A	Design Lab-I	0-0-4	2	15	35	Core
MMD-106A	Design Lab-II	0-0-4	2	15	35	Core
RMI-101	Research Methodology and IPR	2-0-0	2	25	75	Core
AUD	Audit Course – 1	2-0-0	0	-	-	Audit
	Total	**16-0-8**	**18**	**155**	**445**	

Discipline specific Elective-I

MMD-103A-1	Advanced Machine Design
MMD-103A-2	Design for Manufacturing and Assembly
MMD-103A-3	Mathematical Methods in Engineering
MMD-103A-4	Theory of Elasticity

Discipline specific Elective-II

MMD-104A-1	Advanced Engineering Materials
MMD-104A-2	Mechanics of Composite Materials
MMD-104A-3	Analysis and Synthesis of Mechanisms
MMD-104A-4	Metal Forming Analysis ***(Common with M.Tech-Manufacturing Technology & Automation, Manufacturing & Automation, Mechanical Engineering Design)***

Audit course 1 & 2

AUD-01A	English for Research Paper Writing
AUD-02A	Disaster Management
AUD-03A	Sanskrit for Technical Knowledge
AUD-04A	Value Education
AUD-05A	Constitution of India
AUD-06A	Pedagogy Studies
AUD-07A	Stress Management by Yoga
AUD-08A	Personality Development through Life Enlightenment Skills

Second Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
MMD-201A	Finite Element Method	3-0-0	3	25	75	Core-III
MMD-202A	Computer Aided Design	3-0-0	3	25	75	Core-IV
MMD-203A	Discipline specific Elective-III	3-0-0	3	25	75	Programme Elective-III
MMD-204A	Discipline specific Elective-IV	3-0-0	3	25	75	Programme Elective-IV
MMD-205A	Design Lab-III	0-0-4	2	15	35	Core
MMD-206A	Design Lab-IV	0-0-4	2	15	35	Core
AUD	Audit Course – 2	2-0-0	0	-	-	Audit
MMD-207A	Mini-Project	0-0-4	2	25	75	Core
	Total	**14-0-12**	**18**	**155**	**445**	

Discipline specific Elective-III

MMD-203A-1	Tribology in Design
MMD-203A-2	Robotics
MMD-203A-3	Fracture Mechanics
MMD-203A-4	Design of Pressure Vessel

Discipline specific Elective-IV

MMD-204A-1	Multi-body Dynamics
MMD-204A-2	Condition Based Monitoring
MMD-204A-3	Optimization Techniques in Design

Third Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
MMD-301A	Discipline specific Elective-V	3-0-0	3	25	75	Programme Elective-V
	Open Elective	3-0-0	3	25	75	Open Elective
MMD-302A	Dissertation Phase – I	0-0-20	10	50	150	Dissertation
	Total	**6-0-20**	**16**	**100**	**300**	

Discipline specific Elective-V

MMD-301A-1	Advanced Finite Element Method
MMD-301A-2	Advanced Metallurgy
MMD-301A-3	Design of Bearing & Shaft

Open Elective

OEC-101A	Business Analytics
OEC-102A	Industrial Safety
OEC-103A	Operations Research
OEC-104A	Cost Management of Engineering Projects
OEC-105A	Composite Materials
OEC-106A	Waste to Energy

Fourth Semester:

Subject Code	Subject Name	L-T-P	Credits	Marks Weightage		Course Type
				Internal	External	
MMD-401A	Dissertation Phase – II	0-0-32	16	125	375	Dissertation
	Total	**0-0-32**	**16**	**125**	**375**	

Total Credits for the programme = 18 + 18 +16 +16 = **68**

Student Grades

The academic performance of a student shall be graded on a TEN – POINT SCALE and the award of grades based upon marks obtained out of 100 shall be made as follows:-

Marks percentage	Grade	Grade points	Category
90-100	O	10	Outstanding
80≤ marks<90	A+	9	Excellent
70≤ marks<80	A	8	Very Good
60≤ marks<70	B+	7	Good
50≤ marks<60	B	6	Above Average
45≤ marks<50	C	5	Average
40≤ marks<45	P	4	Pass
< 40	F	0	Fail
…….	Ab	0	Absent

Cumulative Grade Point Average (CGPA)

A student is required to maintain a Cumulative Grade Point Average (CGPA) which is the weighted average of all the Letter Grade obtained by the student since his/her entry into the Institute upto and including the latest semester and computed as follows:

$$CGPA = \sum(C_i G_i)/ \sum C_i$$

Where C_i denotes credits assigned to i^{th} course and G_i indicates the Grade point equivalent to the Letter Grade obtained by the students to the i^{th} course. Provided that when a student re-appears in/repeats a course, the new Grade will replace the earlier one in the calculations of the CGPA.

Note:

i. At the end semester (i.e. after End Semester Examination), students will be supplied a DMC indicating the grades secured in each course, Semester Grade Point Average (SGPA) and up-to-date CGPA.

ii. Multiplication factor for converting the CGPA in percentage will be provided on the respective Detailed Marks Certificate (DMC).

Semester I

MMD-101A Advanced Stress Analysis

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. Students will understand the tonsorial approach of continuum mechanics and comprehend modern research material.
2. Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship.
3. Students will be able to apply basic field equations to torsion, bending and two dimensional elasticity problems, and energy methods.
4. Students will be able to solve problems in unsymmetrical bending and shear center, contact stresses and pressurized cylinders and rotating discs.

Syllabus Contents

Unit 1: Theory of Elasticity

Analysis of stress, Analysis of stain, Elasticity problems in two dimension and three dimensions, Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates.

Unit 2. Energy Methods

Energy method for analysis of stress, strain and deflection **T**he three theorem's -theorem of virtual work, theorem of least work, Castiglioni's theorem, Rayleigh Ritz method, Galekin's method, Elastic behavior of anisotropic materials like fiber reinforced composites.

Unit 3. Theory of Torsion

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft.

Unit 4. Unsymmetrical Bending and Shear Centre

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.

Unit 5. Pressurized Cylinders and Rotating Disks

Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc**.**

Unit 6. Contact stresses

Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area. Introduction to Analysis of low speed impact.

References:

1. Sadd, Martin H., Elasticity: Theory, applications and Numeric, Academic Press

2. Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons.

3. Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999

4. Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991

5. Theory of Elasticity – Timoshenko and Goodier, Mc Graw Hill

6. Advanced Strength of Materials, Vol. 1,2 – Timoshenko, CBS

7. Advanced Strength of Materials – Den Harteg

MMD-102A Advanced Vibrations and Acoustics

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations. They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
2. The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the Eigen-values and mode shapes of natural vibrations and response to harmonic and arbitrary excitations.
3. The students will be able to obtain the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes.
4. Student will be able to obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunckerley's method, and Stodola's method.
5. Student will know various terminologies used in acoustics and acoustic wave transmission, derive plane and spherical wave equations, and obtain sound pressure level at a given distance from a simple sound source of known strength.
6. Students should understand the basics of psychoacoustics, equal loudness contours, dBA scale, loudness, pitch and timbre.

Syllabus Contents

Unit 1: Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function.

Unit 2: Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion.

Unit 3: Continuous Systems, Natural Vibrations of beams – Differential equation of motion, solution by the method of separation of variables, frequency parameter, natural frequencies and mode shapes, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method, discretized models of continuous systems and their solutions using Rayleigh – Ritz method.

Unit 4: Vibration Control, Methods of vibration control, principle of superposition, Numerical and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's methods, matrix iteration method for Eigen-value calculations, Holzer's method.

Unit 5: Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source.

Unit 6: Psychoacoustics, Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise.

References:

1. Thomson W.T., "Theory of Vibrations with applications", George Allen and Unwh Ltd. London, 1981.
2. S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.
3. Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition.
4. S. Timoshenko, "Vibration problems in Engineering", Wiley, 1974.

5. Lawrence E. Kinsler and Austin R.Frey, “Fundamentals of acoustics”, Wiley Eastern Ltd., 1987.

6. Michael Rettinger, “Acoustic Design and Noise Control”, Vol. I & II. , Chemical Publishing Co., New York, 1977.

MMD-103A-1 Advanced Machine Design

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. Students will realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centered market.
2. Students will demonstrate the ability to identify needs of the customer and convert them in to technical specifications of a product.
3. Students will be able to generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose.
4. Students will understand the principals used while designing for manufacture, assembly, emotions and maintenance.
5. Students will know various methods of rapid prototyping the products to test and modify the designs.
6. Students will be able to design the components considering strength based reliability.

Syllabus Contents:

Unit 1: Development processes and organizations, Product Planning.

Unit 2: Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing.

Unit 3: Design for manufacture, assembly, maintenance, casting, forging.

Unit 4: Design for Reliability, strength based reliability, parallel and series systems, robust design.

Unit 5: Industrial design: Design for Emotion and experience, Introduction to retrofit and Eco design, Human behavior in design.

Unit 6: Rapid Prototyping.

References:

1. George E Dieter, "Engineering Design", McGraw Hill Company.
2. Prashant Kumar, "Product Design, Creativity, Concepts and Usability", Eastern Economy Edition, PHI New Delhi.
3. Woodson T.T., "Introduction to Engineering Design", McGraw Hill Book Company, 1966.
4. John J.C. "Design Methods", Wiley Inter science, 1970.
5. Averill M. Law and W. David Kelton "Simulation, modelling and analysis", McGraw Hill Book Company, 1991.
6. Pahl, G.and W.Beitz, Engineering Design–A Systematic Approach – Springer, 2nd Ed.,1996.
7. Product Design and development Karl T. Ulrich, Steven Eppinger.

MMD-103A-2 Design for Manufacturing and Assembly

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes: At the end of the course, the student should be able to

1. Understand the product development cycle
2. Know the manufacturing issues that must be considered in the mechanical engineering design process
3. Know the principles of assembly to minimize the assembly time
4. Know the effect of manufacturing process and assembly operations on the cost of product (not included by others)
5. Be familiar with tools and methods to facilitate development of manufacturer mechanical designs.

Syllabus Contents:

Unit 1: Introduction Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

Unit 2: Properties of Engineering Materials, Selection of Materials, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies.

Unit 3: Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Cos-election of Materials and Processes, Case-Studies.

Unit 4: Design for Assembly, Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies.

Unit 5: Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization.

References:

1. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann.
2. G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY
3. M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999.
4. T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY.
5. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
6. S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
7. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
8. J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.
9. Houldcroft, Which Process – an introduction to welding and related processes and guide to their selection, Cambridge, Abington Pub., 1990.
10. ASTM Design handbook.

MMD-103A-3 Mathematical Methods in Engineering

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Apply statistical techniques to analyze multivariate functions.
2. Identify and solve engineering problems by applying the knowledge of ordinary and partial differential equations.
3. Identify nature of a given wave equation and solve by applying D'Alembert solution and/or method of solution of method of separation of variables.

Course Contents

Unit 1 : Introduction to Probability Theory

Probability Theory and Sampling Distributions. Basic probability theory along with examples. Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like X^2, t, F.

Unit 2 : Testing of Statistical Hypothesis

Testing a statistical hypothesis, tests on single sample and two samples concerning means and variances.ANOVA: One – way, Two – way with/without interactions.

Unit 3 : Ordinary Differential Equations:

Ordinary linear differential equations solvable by direct solution methods; solvable nonlinear ODE's.

Unit 4: Partial Differential Equations and Concepts in Solution to Boundary Value Problems:

First and second order partial differential equations; canonical forms.

Unit 5: Major Equation Types Encountered in Engineering and Physical Sciences

Solution methods for wave equation, D'Alembert solution, potential equation, properties of harmonic functions, maximum principle, solution by variable separation method.

Text Books:

1. Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers and Scientists (8th Edition), Pearson Prentice Hall, (for Units I & II)

2. J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi, (for Units III & IV).

Reference Books:

1. Douglas C. Montgomery, Design and Analysis of Experiments (7th Edition), Wiley Student Edition.

2. S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition.

3. William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and Statistics for Engineering, (4th Edition), Willey Student edition, 06.

4. Advanced Engineering Mathematics (9th Edition), Erwin Kreyszig, Wiley India.

MMD-103A-4 THEORY OF ELASTICITY

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes: At the end of the course, the student shall be able:

1: To study the basics of stress

2: To calculate stress in different direction and for different bodies

3: To determine the failure of material under stress

4: To analyse Torsion and its effects

Syllabus

Unit 1

State of stress at a point, stress notations, state of strain at a point and notations, states of plane stress and plane strain. Hooke's law and generalized statement of Hooke's law, stress-strain relationships. Concept of principal stress and strain, Mohr's circle.

Unit 1I

Compatibility equations, stress function, use of stress function in solution of two dimensional problems in Cartesian coordinates, boundary conditions. Problems of cantilever, supported beam under distributed load of uniform and uniformly variable intensity. Use of Fourier series.

Unit 1II

Two dimensional elasticity problems in polar coordinates, equation of equilibrium. Axi-symmetric problems, thick cylinder, curved bars. Hole in a plate problem. Idea of an edge dislocation

Unit 1V

Torsion of straight bars, elliptic and circular section. Membrane analogy, torsion of thin rectangular section. Application of energy method to torsion problem. Torsion of thin tubes.

Unit V

Complex variables for curvilinear coordinates, Laplace's equation. Complex stress function and corresponding displacements. Curvilinear coordinates and stress components - elliptic hole in a uniformly stressed plate.

Unit VI

Uniform stress stretching of a prismatical bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

Text Book(s):

1. Theory of Elasticity by SP Timoshenko; McGraw-Hill (International student edition).

Reference Book(s):

1. Applied Elasticity by Zhilun Xu; Wiley Eastern Ltd.
2. Applied Elasticity by Chi-Teh Wang; McGraw-Hill.
3. Theory of elasticity by Chandramoulli; yes Dee Publishing

MMD-104A-1 Advanced Engineering Materials

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course the student will

1. Demonstarte an understanding of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites.
2. Understand existence of imperfections and their effects on mechanical properties of materials and cause of failure.
3. Demonstrate understanding of phase diagrams and their use in predicting phase transformation and microstructure.
4. Understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact.
5. Know Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composites.
6. Understand the economic considerations in usage and recycling of materials in human use.

Syllabus Contents

Unit 1. Introduction, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids:

Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and non-crystalline materials. Miller indices. Anisotropic elasticity. Elastic behaviour of composites. Structure and properties of polymers. Structure and properties of ceramics.

Unit 2: Imperfections in Solids and Mechanical Properties of Metals, Diffusion, Dislocations and Strengthening Mechanisms:

Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Interpretation of tensile stress-strain curves Yielding under multiaxial stress. Yield criteria and macroscopic aspects of plastic deformation. Property variability and design factors, Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. Mechanisms of strengthening in metals. Recovery, recrystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles. Lattice resistance to dislocation motion.

Unit 3: Phase Diagrams

Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron carbon system.

Unit 4: Failure:

Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile brittle transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep. Generalized creep behaviour. Stress and temperature effects.

Unit 5: Applications and Processing of Metals and Alloys, Polymers, Ceramics, and composites:

Types of metals and alloys. Fabrication of metals. Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics, Mechanical behaviour of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types. Polymer synthesis and processing, Particle reinforced composites. Fibre reinforced composites. Structural composites.

Unit 6. Electrical, Thermal, Optical and Magnetic Properties and economic Considerations:

Electrical conduction. Semi conductivity. Super conductivity. Electrical conduction in ionic ceramics and in polymers. Dielectric behaviour. Ferroelectricity. Piezoelectricity Heat capacity. Thermal expansion. Thermal conductivity. Thermal stresses Diamagnetism and Para magnetism. Ferromagnetism .Anti ferromagnetism and ferrimagnetism. Influence of temperature on magnetic behaviour. Domains and Hysteresis, Basic concepts. Optical properties of metals. Optical properties of non-metals. Application of optical phenomena. Economic, Environmental and Social Issues of Material Usage - Economic considerations. Environmental and societal considerations. Recycling issues. Life cycle analysis and its use in design

References:

1. Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons.

2. Modern Physical Metallurgy and Material Engineering, Science, Process, application, Smallman R.E., Bishop R J, Butterworth Heinemann, Sixth Ed., 1999.

MMD-104A-2 Mechanics of Composite Materials

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

The student should be able to

1. Student will be able to understand the basic concepts and difference between composite materials with conventional materials.
2. Students will be able to understand role of constituent materials in defining the average properties and response of composite materials on macroscopic level.
3. Students will be able to apply knowledge for finding failure envelopes and stress-strain plots of laminates.
4. Students will be able to develop a clear understanding to utilize subject knowledge using computer programs to solve problems at structural level.

Syllabus Contents:

Unit 1. Introduction Definition and characteristics, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus.

Unit 2. Basic Concepts and Characteristics

Structural performance of conventional material, Geometric and physical definition, Material response, Classification of composite materials, Scale of analysis; Micromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials.

Unit 3. Elastic Behavior of Unidirectional Lamina

Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters.

Unit 4. Strength of Unidirectional Lamina

Micromechanics of failure; failure mechanisms, Macro-mechanical strength parameters, Macromechanical failure theories, Applicability of various failure theories.

Unit 5. Elastic Behavior of Laminate

Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates.

Unit 6. Stress and Failure Analysis of Laminates

Types of failures, Stress analysis and safety factors for first ply failure of symmetric laminates, Micromechanics of progressive failure; Progressive and ultimate laminate failure, Design methodology for structural composite materials.

References:

1. Isaac M. Daniels, Ori Ishai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 1994.

2. Bhagwan D. Agarwal, Lawrence J. Broutman, "Analysis and Performance of fiber composites", John Wiley and Sons, Inc. 1990.

3. Mathews, F. L. and Rawlings, R. D., "Composite Materials: Engineering and Science", CRC Press, Boca Raton.

4. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press.

5. Mazumdar S. K., "Composaite Manufacturing – Materials, Product and Processing Engineering", CRC Press, Boca Raton.

6. Robert M. Jones, "Mechanics of Composite Materials", Taylor and Francis, Inc., 1999.

MMD-104A-3 Analysis and Synthesis of Mechanisms

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. To develop analytical equations describing the relative position, velocity and acceleration of all moving links.
2. To select, configure, and synthesize mechanical components into complete systems.
3. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
4. Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
5. Analyze and animate the movement of planar and spherical four-bar linkages.
6. Apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.
7. Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.

Syllabus Contents:

Unit 1

Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.

Unit 2

Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.

Unit 3

Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms.

Unit 4

Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.

Unit 5

Coupler Curves : Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry.

Unit 6

Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms.

References:

1. R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.

2. Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition

3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons New York.

4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York.

5. A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.

6. A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.

7. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.

8. J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.

MMD-104A-4 Metal Forming Analysis

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

To study effects of temperature and strain rate in metal working and application of finite element methods to metal forming processes. To study plastic deformation problems for metal forming analysis and analysis of important metal forming processes.

Course Outcomes:

At the end of the course students will be able to

1. Understand application of finite element methods to metal forming processes.
2. Understand the formulations of plastic deformation problems for metal forming analysis.
3. Understand technology and analysis of important metal forming processes- forging, rolling, extrusion, wire drawing, sheet metal forming processes.
4. Understand the thermos-mechanical problem formulation.
5. Analyse the effect of friction and lubrication in hot and cold working of materials.

Syllabus Contents

Unit 1:

Stress- Strain relations in Elastic and plastic Deformations, Yield Criteria for Ductile Metals, Work hardening and Anisotropy in Yielding, Flow Curves.

Unit 2:

Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, Upper and lower Bound methods, Slip line field theory.

Unit 3:

Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working. Technology and analysis of important metal forming processes- Forging, Rolling, Extrusion. Wire drawing, Sheet Metal forming processes like Deep drawing, Stretch forming, Bending.

Unit 4:

Application of Finite Element Methods to Metal Forming Processes- special Discretization, Shape function, Stiffness matrices and their assembly, Implicit and explicit formulations, Elasto-plastic approximations, Lagrangian Vs Eularian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation, steady state solutions for Drawing, Forging, rolling and extrusion problems.

Unit 5:

Case Studies- analysis and validation of metal forming processes problems by standard softwares.

Unit 6:

Forming defects in products and their critical effects, remedies.

Unit 7:

An introduction to use of International standards in Metal Forming Problem solutions and system Design

Reference Books:

1. Metal Forming Analysis- R. H. Wagoner, Cambridge University Press.
2. Theory of Elasticity- Dally and Riley
3. Physical Metallurgy- Dieter, McGraw Hill Inc.
4. Metal Forming Handbook by H Frontzek, M Kasparbauer , Springer Verleg

MMD-105A DESIGN LAB-I

No. of Credits: 2
L T P Total
0 0 4 4

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks

List of Experiments:

1. Modeling in 2D and image scanning using ProE.
2. Modeling in 3D of machine tool parts like gear details, machine tool beds, tailstocks and assembly drawings of machine tools like lathe machine components, power drives, jigs & fixtures, power presses etc using ProE.
3. Use of various types of surfaces in 3D modeling, animation features and other editing entities in machine tool assemblies in ProE.
4. Kinematic and dynamic simulation of various mechanisms in machines, process simulation like Pro-Cast, Pro-Mould and other machining features.
5. Tool path generation, Part Programing – G & M code development for machining operations using ProE Physical interpretation of machining features and tool geometries.

MMD-106A DESIGN LAB-II

No. of Credits: 2
L T P Total
0 0 4 4

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks

List of Experiments

1. Experiments using strain gauges.
2. Measurement of strain, temperature effects
3. Fixing of gauges on surfaces.
4. Experiments using photo elastic bench.
5. Setting of polariscope and calibration of disc, beam and tension model.
6. Experiments on measurement of linear displacement and motion by LVDT; Temperature measurement by RTD Thermistor and Thermocouple;pressure and fluid flow.
7. Applications of plotters and recorders, Inductive Pick up Strain Gauge based cantilever, the load measurement by load cell and strain gauge based cantilever.
8. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils
9. Determination of steady state amplitude of a forced vibratory system
10. Static balancing using steel balls
11. Determination of the magnitude and orientation of the balancing mass in dynamic balancing
12. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
13. Determination of natural frequency of given structure using FFT analyzer

RMI-101 Research Methodology and IPR

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Objectives:

The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding and formulation of research problem.
2. Analyze research related information.
3. Understand plagiarism and follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research

problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Semester II

MMD-201A Finite Element Method

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course,

For one and two dimensional, linear, static and dynamic problems in Structural Mechanics and Heat Transfer, the student will be able to demonstrate the learning outcomes as mentioned below:

1. The student will be able to classify a given problem on the basis of its dimensionality as 1- D, 2-D, or 3-D, time-dependence as Static or Dynamic, Linear or Non-linear.
2. The students will be able to develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential.
3. While demonstrating the process mentioned in 2 above, he will be able to identify the primary and secondary variables of the problem and choose correct nodal degrees of freedom and develop suitable shape functions for an element, implement Gauss-Legendre scheme of numerical integration to evaluate integrals at element level, and assemble the element level equations to get the system level matrix equations. He will also be able to substitute the essential boundary conditions correctly and obtain the solution to system level matrix equations to get the values of the field variable at the global nodes.
4. The student will be able to state three sources of errors in implementing FEM and suggest remedies to minimize the same for a given problem, viz. Modeling errors, Approximation errors, and numerical errors.

5. The student will be able to obtain consistent and lumped mass matrices for axial vibration of bars and transverse vibration of beams and obtain fundamental frequency of natural vibration using the methods mentioned in the curricula.
6. The students will be able use MATLAB for implementation of FEM to obtain elongations at nodes of a bar subjected to traction and concentrated loads and prescribed boundary conditions.
7. The students will be able to use commercial software like ANSYS or ABAQUS for implementation of FEM to obtain stress concentration due to a small hole in a rectangular plate subjected to traction on edges and concentrated loads at points on the edges and prescribed boundary conditions.

Syllabus Contents:

Unit 1: Introduction, Classification of problems – Dimensionality, time dependence, Boundary Value problems, Initial value problems, Linear/Non-linear, etc,

Unit 2: Differential equation as the starting point for FEM, steps in finite element method, discretization, types of elements used, Shape functions, Linear Elements, Local and Global coordinates, Coordinate transformation and Gauss-Legendre scheme of numerical integration, Nodal degrees of freedom,

Unit 3: Finite element formulation, variational, weighted residual and virtual work methods.

Unit 4: 1-D and 2-D problems from Structural Mechanics – Bar, Beam, Plane stress and plane strain problems, Axisymmetric problems – Axi-symmetric forces and geometry.

Unit 5: computer implementation, higher order elements, iso-parametric formulation.

Unit 6: Eigen-value problems, Natural vibration of bars and beams, Methods to find eigen-values and eigen-vectors.

References:

1. Chandrupatla and Belegundu "Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd. New Delhi, Ed.4.

2. Logan Deryl L., "A First Course in Finite Element Method", Thomson Brook/Cole, 5th Ed.

3. Cook R.D. "Concepts and applications of finite element analysis" Wiley, New York, 4th Ed.

4. Reddy J N, "Finite element Method", Tata McGraw Hill publishing Co Ltd, New Delhi, 3rd Ed..

5. Bathe K.J., Cliffs, N.J. "Finite Element Procedures in Engineering Analysis", PHI Learning, Eastern Economy Editions, 09.

MMD-202A Computer Aided Design

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. Have a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
2. Understand 2D, 3D transformations and projection transformations.
3. Get knowledge of various approaches of geometric modeling.
4. Understand mathematical representation of 2D and 3D entities.
5. Understand basic fundamentals of FEM.

Syllabus Contents:

Unit 1: CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules.

Unit 2: Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems.

Unit 3: Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping.

Unit 4 : Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation.

Unit 5 : Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc.

Unit 6: Finite Element Modeling and Analysis, Finite Element Analysis, finite element modeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, types of models, types of simulation approaches.

References:

1. Ibrahbim Zeid, "CAD / CAM Theory and Practice".
2. Jim Browne, "Computer Aided Engineering and Design".
3. P. Radhakrishnan / V. Raju / S. Subramanyam, "CAD / CAM / CIM".
4. P.N. Rao, "CAD / CAM principles and applications", Tata Mcraw-Hill.
5. Rogers / Adams, "Mathematical Elements for Computer Graphics".
6. Rooney and Steadman, "Principles of Computer Aided Design", Aug. 1993.
7. Jerry Banks / John Carson / Barry Nelson / David Nicol, "Discrete-Event System Simulation"

MMD-203A-1 Tribology in Design

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. The students will be able to apply theories of friction and wear to various practical situations by analysing the physics of the process.
2. They will understand the various surface measurement techniques and effect of surface texture on Tribological behavior of a surface.
3. They will be able to select materials and lubricants to suggest a tribological solution to a particular situation.
4. The students will be able to design a hydrodynamic bearing using various bearing charts.
5. The students will be able to understand the recent developments in the field and understand modern research material.

Syllabus Contents:

Unit 1: Friction, theories of friction, Friction control, Surface texture and measurement, genesis of friction, instabilities and stick-slip motion.

Unit 2: Wear, types of wear, theories of wear, wear prevention.

Unit 3: Tribological properties of bearing materials and lubricants.

Unit 4: Lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings, Design of hydrodynamic journal bearings.

Unit 5: Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings.

Unit 6: Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings.

References:

1. Cameron, "Basic Lubrication Theory", Ellis Horwood Ltd, 1981.
2. Principles in Tribology, Edited by J. Halling, 1975
3. Fundamentals of Fluid Film Lubrication – B. J. Hamrock, McGraw Hill International,1994.
4. D.D. Fuller, "Theory and Practice of Lubrication for Engineers", John Wiley and Sons, 1984.
5. "Fundamentals of Friction and wear of Materials" American Society of Metals.
6. Introduction to Tribology of Bearings –B. C. Majumdar, A. H. Wheeler &co. pvt. Ltd 1985.
7. T.A. Stolarski, "Tribology in Machine Design".

MMD-203A-2 Robotics

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course students will be able to

1. Understand basic terminologies and concepts associated with Robotics and Automation.
2. Demonstrate comprehension of various Robotic sub-systems.
3. Understand kinematics and dynamics to explain exact working pattern of robots.
4. aware of the associated recent updates in Robotics.

Syllabus Contents

Unit 1 Introduction:

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

Unit 2 Robot Grippers:

Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

Unit 3 Drives and control systems:

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others.

Unit 4 Kinematics:

Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain. Dynamics:- Introduction to Dynamics , Trajectory generations.

Unit 5 Machine Vision System:

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

Unit 6 Modeling and Simulation for manufacturing Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation. Artificial Intelligence:- Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics.

References:

Text Books:

1. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition.

2. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.

3. Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co.

4. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.

5. Industrial Automation: W.P. David, John Wiley and Sons.

Reference Books:

1. Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India.

2. Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

MMD-203A-3 Fracture Mechanics

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral, Crack tip opening displacement.
2. Students will be able to manage singularity at crack tip using complex variable.
3. Students will understand important role played by plastic zone at the crack tip.
4. Students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.
5. Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

Syllabus Contents:

Unit 1: Modes of fracture failure, Brittle and ductile fracture.

Unit 2: Energy release rate: crack resistance, stable and unstable crack growth.

Unit 3: Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks.

Unit 4: Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement.

Unit 5: Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral.

Unit 6: Fatigue failure: Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques.

References:

1. Brook D, “Elementary engineering fracture mechanics”.

2. Liebowitz H., “Fracture” Volume I to VII.

3. A Nadai, W. S. Hemp, “Theory of flow and fracture of solids”, McGraw Hill Book Company, 1950.

MMD-203A-4 DESIGN OF PRESSURE VESSELS

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes: At the end of the course, the student shall be able:

1: To study basics of pressure pipe designing and its various standards

2: To understand the design of pressure vessels and various parts

3: To verify the testing and failures of design vessels under thermal and fatigue load

4: To explore testing and failure of design vessels under external loads

Course contents

Unit 1

Introduction to basic piping design criteria and codes

Unit 1I

Pressure Design: Wall thickness determination under external pressure, internal pressure and vacuum pressure.

Unit III

External Loads and Fatigue Design: Flexibility, fatigue, stress intensity factors, combined load (sustained wind, earth quake), Cold spring.

Unit 1V

Pipe Support Design: Support types assumptions, load combinations, variable supports, lugs and attachments, pressure relief, Materials, Fabrication, Inspection and Testing.

Unit V

Design of Pressure vessels subjects to internal pressure, external pressure, design of penetration, design of flanges, cone cylinder junctions. Prediction of thermal and hydraulic loads, Materials, Fabrication, Inspection and Testing.

Unit VI

Pressure vessel materials and their environment: Introduction, ductile material tensile tests, structure and strength of steel, Leuder's lines, determination of stress patterns from plastic flow observations, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth, fatigue life prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.

Text Book(s):

1. Pressure Vessels: Design and Practice by Somnath Chattopadhyay; CRC Press

Reference Book(s):

1. Pressure Vessel Design by Donatello Annaratone
2. Pressure Vessels and Piping: Codes, Standards, Design and Analysis by Baldev Raj
3. Pressure Vessel Design: Concepts and principles by J Spence, A S Tooth

MMD-204A-1 Multi-body Dynamics

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of this course, the students will be able to:

1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motion.
2. Implement and analyze methods of formulating equations of motion for interconnected bodies.
3. Write programs to solve constrained differential equations for analyzing multi-body systems.
4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis.
5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems.
6. Demonstrate an improved technical writing and presentation skills.

Syllabus Contents

Unit 1. Introduction: The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints.

Unit 2. Basic principles for analysis of multi-body systems:

The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations.

Unit 3. Dynamics of Planar Systems: Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for

actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints.

Unit 4. Kinematics of rigid bodies in space: Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

Unit 5. Kinematic analysis of spatial systems: Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems.

Unit 6. Computation of Forces: Computation of spatial generalized forces for external forces and for actuator-spring-damper element. Computation of reaction forces from Lagrange's multipliers.

References:

1. Wittenburg, J., Dynamics of Systems of Rigid Bodies, B.G. Teubner, Stuttgart, 1977.

2. Kane, T.R, Levinson, D.A., Dynamics: Theory and Applications, McGraw-Hill Book Co., 1985.

3. Nikravesh, P.E., Computer Aided Analysis of Mechanical Systems, Prentice-Hall Inc., Englewood Cliffs, NJ, 1988.

4. Roberson, R.E., Schwertassek, R., Dynamics of Multibody Systems, Springer-Verlag, Berlin, 1988.

5. Haug, E.J., Computer-Aided Kinematics and Dynamics of Mechanical Systems-Basic Methods, Allyn and Bacon, 1989.

6. Huston, R.L., Multibody Dynamics, Butterworth-Heinemann, 1990.

7. Schielen, W. ed., Multibody Systems Handbook, Springer-Verlag, Berlin, 1990.

8. de Jalo n, J.C., Bayo, E., Kinematic and Dynamic Simulation of Multibody Systems, Springer-Verlag, 1994.

9. Shabana, A.A., Computational Dynamics, John Wiley & Sons, 1994.

Reference Books:

1. "Why Do Multi-Body System Simulation?" by Rajiv Rampalli, Gabriele Ferrarotti & Michael Hoffmann, Published NAFEMS Publications.

2. “Principles of Dynamics” by Donald T. Greenwood, 2nd ed., Prentice Hall.

MMD-204A-2 Condition Based Monitoring

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

1. To know and be able to explain the aim and the basics of CM
2. be aware of some methods and procedures applied for general CM;
3. Appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring, know the general stages of CM;
4. be able to apply some basic techniques for analysis of random and periodic signals;
5. Know the basics of Vibration of Linear Systems: time and frequency response, resonance;
6. Be aware of some basic instrumentation used for machinery and structural vibration-based monitoring;
7. be aware of some basic faults in rotating machinery, their manifestation and methods for detection and recognition: low frequency, medium frequency and high frequency.

Syllabus Contents

Unit 1. The basic idea of health monitoring and condition monitoring of structures and machines. Some basic techniques.

Unit 2. Basics of signal processing: Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions of commonly found systems, spectral analysis.

Unit 3. Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals. Response of linear systems to stationary random signals: FRFs, resonant frequencies, modes of vibration.

Unit 4. Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments.

Unit 5. Typical applications of condition monitoring using vibration analysis to rotating machines.

Unit 6. Some other health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications.

References:

1. M.Adams, Rotating machinery analysis - from analysis to troubleshooting, Marcel Dekker, New York, ISBN 0-8247-0258-1.

2. Cornelius Scheffer Paresh Girdhar, Practical Machinery Vibration Analysis and Predictive Maintenance, Newnes, 1st Edition, Paperback ISBN: 9780750662758.

MMD-204A-3 Optimization Techniques in Design

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course:

1. Students will know the principles of optimization.
2. Students will have knowledge of algorithms for design optimization
3. Students will be able to formulate an optimization problem.
4. Students should be able to find the optimum solution of their problems using optimization techniques.

Syllabus Contents:

Unit 1: Introduction to optimization, classification of optimisation problems, classical optimization techniques.

Unit 2: Linear programming, simplex method and Duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's methods.

Unit 3:Non-Linear Programming: - One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods.

Unit 4: Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts, etc.

Unit 5: Introduction to Genetic Algorithms, Operators, applications to engineering optimization problems.

References:

1. S. S. Stricker, "Optimising performance of energy systems" Battelle Press, New York, 1985.

2. R.C. Johnson, "Optimum Design of Mechanical Elements", Willey, New York, 1980.

3. J. S. Arora, "Introduction to Optimum Design", McGraw Hill, New York, 1989.

4. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India, New Delhi.

5. L.C.W. Dixon, "Non-Linear Optimisation - Theory and Algorithms", Birkhauser, Boston, 1980.

6. R.J. Duffin, E.L. Peterson and C.Zener "Geometric Programming-Theory and Applications", Willey, New York, 1967.

7. G.B. Dantzig "Linear Programming and Extensions Princeton University Press", Princeton, N. J., 1963.

8. R. Bellman "Dynamic Programming-Princeton" University Press, Princeton, N.J. 1957.

MMD-205A DESIGN LAB-III

No. of Credits: 2
L T P Total
0 0 4 4

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks

Course Objective:

The objective of the course is to make the students familiar with basics of computer aided drafting and designing.

Course Outcomes: At the end of the course, the student shall be able:

1. To understand the code of rotation
2. To define code for orthogonal projection, isometric projection
3. To study code dimetric projection, perspective projection
4. To able to integrate various curves like spline curve, Bezier curve etc

Syllabus

Section-I

1. Develop a general purpose code to carry out the rotation of an object about an axis through two points.

2. Develop a general purpose code to carry out orthogonal projection, dimetric projection (given foreshortening factor F_z), isometric projection, perspective projection given Z_c, φ, Θ.

3. Develop a general purpose code, given two arbitrary projections and the respective transformation matrices and the reconstructed coordinates of the vertices of the object.

4. Develop a general purpose code to carry out the reflection of an object about an arbitrary plane passing through three points.

Section-II

1. Develop a general purpose code for integrated cubic spline with differential boundary conditions, Bezier curve,B- spline- Its various types and best fit B-spline.

Given Coordinates of the control points, boundary conditions, order of the curve, if required, and

Match the output to projected image of any CAD/CAM package.

Section-III

1. Develop an optimized tool path for economic machining and generate the same in GUI (IDEAS/ProE/CAD software) for interpretation.
2. Study of graphics formats and conversion from one format to another.
3. Generate the meshing of the conical cylindrical surface using any simulation package.
4. Study of Open GL programming for the customization of any CAD package.
5. Development of the following surface patches: Bilinear Coons Patch, Tensor Product Bezier surface.

MMD-206A DESIGN LAB-IV

No. of Credits: 2
L T P Total
0 0 4 4

Sessional: 15 Marks
Theory : 35 Marks
Total : 50 Marks

Syllabus

I. Modeling

1. Surface modeling
2. Solid modeling
3. Drafting
4. Assembling

II. Structural Analysis using any FEA Package for different structures that can be discretised with 1-D, 2-D & 3-D elements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites
7. Fracture mechanics

III. Thermal Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Steady state thermal analysis
2. Transient thermal analysis

IV. Transient analysis using any FEA Package for different structures that can be discretised with 1-D, 2-D & 3-D elements

1. Linear
2. Non-Linear (Geometrical Non-linearity)

REFERENCES: User manuals of ANSYS package Version 10.0 PRO/E,I-DEAS Package /UNIGRAPHICS,CATIA

MMD-207A Mini-project

No. of Credits: 2
L T P Total
0 0 4 4

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks

Course Outcomes:

At the end of the course:

1. Students will get an opportunity to work in actual industrial environment if they opt for internship.
2. In case of mini project, they will solve a live problem using software/analytical/computational tools.
3. Students will learn to write technical reports.
4. Students will develop skills to present and defend their work in front of technically qualified audience.

Syllabus Contents:

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Semester –III

MMD-301A-1 Advanced Finite Element Method

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course, the students will be able to

1. Demonstrate understanding of FE formulation for linear problems in solid mechanics
2. Understand behaviour of elastic-plastic materials and visco-plasticity, Use of Newton-Raphson method for solving nonlinear equations of equilibrium.
3. Understand flow rules and strain hardening, loading and unloading conditions, Drucker's stability postulates, J2 flow of theory of plasticity.
4. Demonstrate use of FE formulation to solve the problems of large deformation of structures under loads.
5. Able to solve contact problems oby using the techniques of non-linear FEM.

Syllabus Contents

Unit 1. Review of linear FEA:

FE formulation of 1D bar, 3D linear elastic continuum, 2D plane strain, plane stress, and axisymmetric elements; Iso-parametric mapping; numerical integration.

Unit 2. FE formulation for 1D plasticity:

Elastic-perfectly plastic material; Isotropic and kinematic hardening; Integration algorithms for 1D plasticity; FE formulation; Newton-Raphson method for solving nonlinear equilibrium equations; 1D visco-plasticity and integration algorithm.

Unit 3. Continuum theories of plasticity:

Review of tensor algebra; Yield condition, flow rule and hardening rules; loading and unloading conditions; Drucker's stability postulates; Convexity and normality; J2 flow theory of plasticity and visco-plasticity, Gurson model.

Unit 4. FE procedures for 2D and 3D plasticity:

Integration algorithms for rate independent plasticity—explicit forward Euler and implicit backward Euler; Return mapping algorithm; visco-plasticity; FE formulation; Consistent linearization; Algorithmic and consistent tangent modulii; Treatment of incompressible deformation (Locking); B-bar method.

Unit 5. FE procedures for large deformation problems:

Continuum mechanics—deformation gradient, polar decomposition, Green-Lagrange strain, rate of deformation, Cauchy stress, P-K stresses, Balance laws; Principle of objectivity and isotropy; Constitutive equations for hyperelasticity; Neo-Hookean model; FE formulation-Total Lagrangian and updated Lagrangian descriptions; Tangent Stiffness Matrix. Introduction to finite strain plasticity.

U**nit 6. Contact Problems:**

Condition of impenetrability; Gap elements for modelling contact; Tangent stiffness matrix and force vectors for 2D frictionless contact problems.

References:

1) K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited, New Delhi, 1996.

2) J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer-Verlag New York, Inc., New York, 1998.

3) O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, Fifth Edition, Butterworth-Heinemann, Oxford.

4) T. Belytschko and W. K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons Ltd., England.

5) D. R. J. Owen and E. Hinton, Finite Elements in Plasticity: Theory and Practice, Pineridge Press Ltd.

MMD-301A-2 Advanced Metallurgy

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

At the end of the course, the students will be able to:

1. Demonstrate understanding of various aspects of crystal and lattice structure and their imperfection.
2. Understand importance of equilibrium diagrams and their uses in developing materials.
3. Understand the process of heat treatment of different nonferrous alloys and tool steel and decide a heat treatment to acquire their desired properties.
4. Demonstrate acquisition of knowledge of composites, ceramics, orthodontal and biomaterials.

Syllabus Contents:

Unit 1. Aspects of Physical Metallurgy:

Crystal structure, systems and Barvias lattices, Indexing of lattice planes (Miller's Indices), Indexing of lattice directions, Co-ordination Number (Ligency), Density calculations and imperfections in crystals.

Unit 2. Study of Equilibrium diagrams for Fe-C systems, Cu - Bronze alloys i.e. Cu:Zn, Cu:Sn, Cu:Al etc., Developments in metallic materials like HSLA state, maraging steels, dual phased steels, creep resisting steels, materials for high and low temperature applications, Nimerics, Inconels, Haste Alloys etc., Al, Ni alloys, Ti, Mg alloys.

Unit 3. Heat Treatment of Nonferrous alloys, Heat Treatment of Tool steels.

Unit 4. Orthodental materials, Bio material, Prosthetic materials, Nano materials, super conducting materials, sports materials.

Unit 5. Composites, ceramics, cermets, shape memory alloys their manufacturing techniques, advantages and limitations.

Unit 6. Surface coatings and their tribological aspects. PVD, CVD, IVD ion implantation method.

Reference Books

1. Engineering Metallurgy, R. A. Higgins, Viva Books Pvt. Ltd.

2. Elements of Material Science and Engineering, Lawrence H., Van Vlack Addison Wesley Publishing Company

3. Principles of Material Science and Engineering, William F. Smith, McGraw-Hill Book Co.

4. Material Science, R. B. Gupta, Satya Publications, New Delhi.

5. A Text Book of Material Science and Metallurgy, O. P. Khanna, Dhanpat Rai and Sons, New Delhi.

6. Material Science and Engineering an Introduction, William D. Callister, Jr., John Wiley and Sons Inc.

7. Smithells Metals Reference Book, E. A. Brandes and G. B. Brook, Butterworth Heinemann.

8. Biomaterials and Bioengineering Handbook, Donald L. Wise, Marcel Dekker Inc.

MMD-301A-3 DESIGN OF BEARINGS AND SHAFT

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes: At the end of the course, the student shall be able:

1: To study the sliding contact bearing
2: To analyze the rolling contact of bearing
3: To explore various types of shafts.
4: To understand design aspects of shaft and bearings

Syllabus contents

Unit 1: Sliding contact bearings

Bearing classification; tribology and hydrodynamics; factors affecting choice of bearing; characteristics; types of friction in sliding element bearing; viscosity of lubricants; types of sliding contact bearings; Petroffs relation for power loss; unstable and stable lubrication; hydrodynamic theory of bearing: load carrying capacity of bearing; heating of bearings; practical bearing design; finite length bearings; pressure fed bearing; bearing materials: bearing bronzes, babbits, copper lead alloys, aluminium tin alloy, other bearing materials; bearing types; design of journal bearing.

Unit 2: Rolling contact bearings

Types of rolling contact bearing: radial ball bearings, angular contact ball bearings, roller bearings; friction torque due to load; frictional torque due to viscous churning of lubricants; heating of roller bearing; rolling bearing geometry; stress and deformation in rolling element; bearing deflection; permanent deformation in bearings; fatigue of rolling bearing; selection of bearing; load on bearing; combined bearing load; bearing life; equivalent load; bearing dimension code.

Unit 3: Shafts

Materials for shafts; strength of shafts under torsion and bending; factor of safety in shafts: fatigue strength reduction factors, modified moments of inertia of shaft section; stiffness of shafts: factors affecting shaft deflection. Complete design calculation and checking of stress concentration, shafts for power transmission through belts and gears. Shaft vibrations.

Text Book(s):

1. Machine Design by Abdul Mubeen; Khanna Publishers
2. Machine Design by Shiegley; McGraw Hill
3. Design of Machine Elements by Bhandari, McGraw Hill Education

Reference book(s):

1. Machine Design by Black And Adams, McGraw Hill Education
2. Design of Machine Elements by Spotts

MMD-302A Dissertation Phase – I

No. of Credits: 10 Sessional: 50 Marks

L T P Total Theory : 150 Marks

0 0 20 20 Total : 200 Marks

Course Outcomes:

At the end of the course:

1. Students will learn to survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
2. Students will be able to use different experimental techniques.
3. Students will be able to use different software/ computational/analytical tools.
4. Students will be able to design and develop an experimental set up/ equipment/test rig.
5. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
6. Students will be able to either work in a research environment or in an industrial environment.

Syllabus Contents:

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Semester –IV

MMD-401A Dissertation Phase – II

No. of Credits: 16	Sessional: 125 Marks
L T P Total	Theory : 375 Marks
0 0 32 32	Total : 500 Marks

Course Outcomes:

At the end of the course:

1. Students will develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will.
2. Students will learn to write technical reports and research papers to publish at national and international level.
3. Students will develop strong communication skills to defend their work in front of technically qualified audience.

Syllabus Contents:

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

OPEN ELECTIVES

OEC-101A Business Analytics

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit 1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation,

competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books::

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

2. Business Analytics by James Evans, persons Education.

OEC-102A Industrial Safety

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Contents:

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference Books::

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OEC-103A Operations Research

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Outcomes:

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

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit 2 Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Reference Books::

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

5. Pannerselvam, Operations Research: Prentice Hall of India 2010

6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OEC-104A Cost Management of Engineering Projects

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course contents:

Unit 1: Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

Unit 4: Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Reference Books::

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OEC-105A Composite Materials

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course Contents:

UNIT–I: Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method-Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books::

1. Hand Book of Composite Materials-ed-Lubin.

2. Composite Materials – K.K.Chawla.

3. Composite Materials Science and Applications – Deborah D.L. Chung.

4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

OEC-106A Waste to Energy

No. of Credits: 3
L T P Total
3 0 0 3

Sessional: 25 Marks
Theory : 75 Marks
Total : 100 Marks
Duration of Exam: 3 Hours

Course outcomes:

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Reference Books::

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit Courses

AUD-01A English for Research Paper Writing

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Note: Ensure the good quality of paper at very first-time submission

Course Contents:

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Unit 6: useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .

4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUD-02A Disaster Management

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Unit 1: Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit 3: Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Unit 4: Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit 5: Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Unit 6: Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

AUD-03A Sanskrit for Technical Knowledge

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2. Learning of Sanskrit to improve brain functioning.
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Contents:

Unit 1: Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit 2: Order, Introduction of roots, Technical information about Sanskrit Literature.

Unit 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output:

Students will be able to

1. Understanding basic Sanskrit language.
2. Ancient Sanskrit literature about science & technology can be understood.
3. Being a logical language will help to develop logic in students.

AUD-04A Value Education

Course Objectives

Students will be able to

1**.** Understand value of education and self- development.

2. Imbibe good values in students.

3. Let the should know about the importance of character

Course Contents:

Unit 1: Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit 2: Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Unit 3: Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Unit 4: Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Suggested reading

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AUD-05A Constitution of India

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working).

Unit 2: Philosophy of the Indian Constitution: Preamble, Salient Features.

Unit 3: Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Unit 4: Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Unit 5: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different

departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 6: Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

AUD-06A Pedagogy Studies

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Contents:

Unit 1: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

Unit 2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Unit 3: Evidence on the effectiveness of pedagogical practices. Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4: Professional development: alignment with classroom practices and follow-up support, Peer support. Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.

Unit 5: Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUD-07A Stress Management by Yoga

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Course Contents:

Unit 1: Definitions of Eight parts of yog. (Ashtanga)

Unit 2 Yam and Niyam. Do`s and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3: Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects- Types of pranayama.

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve efficiency

AUD-08A Personality Development through Life Enlightenment Skills

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course contents

Unit 1: Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (dont's)

Verses- 71,73,75,78 (do's)

Unit 2: Approach to day to day work and duties.

Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35,

Chapter 18-Verses 45, 46, 48.

Unit 3: Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.

2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.