



**DEPARTMENT OF MECHANICAL ENGINEERING  
AND  
MINING MACHINERY ENGINEERING  
INDIAN SCHOOL OF MINES, DHANBAD**

**COURSE STRUCTURE & SYLLABUS  
FOR  
B. TECH. (MINING MACHINERY ENGG.) PROGRAMME**

Approved by 77<sup>TH</sup> Academic Council held on 03.06.2008  
(Effective from 2007 – 2008)

## COURSE STRUCTURE

### FIRST SEMESTER (GROUP A)

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	AMC11101	Mathematics – I	3	1	0	7
2.	APC11101	Physics	3	1	0	7
3.	MMC11101	Engineering Graphics	1	3	0	5
4.	EEC 11101	Electrical Technology	3	1	0	7
5.	MMC 11103	Engineering Mechanics	3	1	0	7
<b>PRACTICAL &amp; OTHERS</b>						
6.	GLD/CMD 11301	Earth System Science (S) LTP for AGL: 2-0-0 & LTP for ESE: 1-0-0	3	0	0	6
7.	HSC 11301	Value Education, Human Rights & Legislatives (S)	3	0	0	6
8.	APC11201	Physics	0	0	3/2	1.5
9.	EEC 11201	Electrical Technology	0	0	3/2	1.5
10.	DSW	Counseling / Special Classes	0	0	0	0
		<b>Total Credit Hours</b>	<b>19</b>	<b>7</b>	<b>3</b>	<b>48</b>

### FIRST SEMESTER (GROUP B)

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	AMC11101	Mathematics – I	3	1	0	7
2.	ACC11101	Chemistry	3	1	0	7
3.	MMC11102	Manufacturing Process	1	3	0	5
4.	EIC 11101	Electronics Engineering	3	1	0	7
5.	HSC 11101	English for Science & Technology	3	1	0	7
<b>PRACTICAL &amp; OTHERS</b>						
6.	FMD/CMD 11301	Global Energy Scenario & Energy Scenario of India (S) LTP for FME: 2-0-0 & LTP for ESE: 1-0-0	3	0	0	6
7.	CSC 11301	Computer Programming (S)	3	0	0	6
8.	ACC11201	Chemistry	0	0	3/2	1.5
9.	EIC 11201	Electronics Engineering	0	0	3/2	1.5
10.	DSW	Counseling / Special Classes	0	0	0	0
		<b>Total Credit Hours</b>	<b>19</b>	<b>7</b>	<b>3</b>	<b>48</b>

### SECOND SEMESTER (GROUP A)

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	AMC12101	Mathematics – II	3	1	0	7
2.	ACC12101	Chemistry	3	1	0	7
3.	MMC12101	Manufacturing Process	1	3	0	5
4.	EIC 12101	Electronics Engineering	3	1	0	7
5.	HSC 12101	English for Science & Technology	3	1	0	7
<b>PRACTICAL &amp; OTHERS</b>						
6.	FMD/CMD 12301	Global Energy Scenario & Energy Scenario of India (S) LTP for FME: 2-0-0 & LTP for ESE: 1-0-0	3	0	0	6
7.	CSC 12301	Computer Programming (S)	3	0	0	6
8.	ACC12201	Chemistry	0	0	3/2	1.5
9.	EIC 12201	Electronics Engineering	0	0	3/2	1.5
10.	SWC 12701	Counseling / Special Classes / Co-curricular Activities	0	0	0	(3)
<b>Total Credit Hours</b>			<b>19</b>	<b>7</b>	<b>3</b>	<b>48+(3)</b>

### SECOND SEMESTER (GROUP B)

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	AMC12101	Mathematics – II	3	1	0	7
2.	APC12101	Physics	3	1	0	7
3.	MMC12102	Engineering Graphics	1	3	0	5
4.	EEC 12101	Electrical Technology	3	1	0	7
5.	MMC12103	Engineering Mechanics	3	1	0	7
<b>PRACTICAL &amp; OTHERS</b>						
6.	GLD/CMD 12301	Earth System Science (S) LTP for AGL: 2-0-0 & LTP for ESE: 1-0-0	3	0	0	6
7.	HSC 12301	Value Education, Human Rights & Legislatives (S)	3	0	0	6
8.	APC12201	Physics	0	0	3/2	1.5
9.	EEC 12201	Electrical Technology	0	0	3/2	1.5
10.	SWC 12701	Counseling / Special Classes / Co-curricular Activities	0	0	0	(3)
<b>Total Credit Hours</b>			<b>19</b>	<b>7</b>	<b>3</b>	<b>48+(3)</b>

### THIRD SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	MMC13101	Mechanics of Materials I	3	1	0	7
2.	MMC13102	Engineering Thermodynamics	3	1	0	7
3.	MMC13103	Kinematics of Machines	3	1	0	7
4.	MMC13104	Computer Graphics & Geometric Modeling	3	1	0	7
5.	AMR13101	Methods of Applied Mathematics I	4	1	0	9
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC13201	Mechanical Engineering Lab. I	0	0	3	3
7.	MMC13301	Machine Drawing (S)	1	5	0	7
<b>Total Credit Hours</b>			<b>17</b>	<b>10</b>	<b>3</b>	<b>47</b>

### FOURTH SEMESTER

Sl. No.	Course No.	Name of the course	L	T	P	CH
<b>THEORY</b>						
1.	MMC14101	Fluid Mechanics I	3	1	0	7
2.	MMC14103	Mechanical Engineering Design I	3	3	0	9
3.	MER 22132	Mining Methods and Operations	3	0	0	6
4.	EER 14101	Applied Electrical Engineering	3	1	0	7
5.	AMR14101	Numerical and Statistical Methods	4	0	0	8
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC14201	Mechanical Engineering Lab. II	0	0	3	3
7.	AMC14201	Numerical and Statistical Methods	0	0	3	3
8.	MMC14501	Composite Viva-Voce	0	0	0	(4)
9.	SWC14701	Co-curricular activity	0	0	0	(3)
<b>Total Credit Hours</b>			<b>16</b>	<b>5</b>	<b>6</b>	<b>50</b>

### FIFTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	MMC15101	Dynamics of Machinery	3	1	0	7
2.	MMC15103	Production Technology I	3	1	0	7
3.	MMC15104	Mechanical Engineering Design II	3	3	0	9
4.	EER 15101	Mine Electrical Engineering	4	0	0	8
5.	MSR15152	Industrial Engineering and Management	3	0	0	6
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC15201	Mechanical Engineering Lab. III	0	0	3	3
7.	MMC15202	Mechanical Engineering Lab. IV	0	0	3	3
8.	MMC 15011	Vocational Training *	0	0	0	5
<b>Total Credit Hours</b>			<b>16</b>	<b>5</b>	<b>6</b>	<b>48</b>

\* Vocational training performed after IV-th Semester is to be credited in V-th Semester.

### SIXTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	MMC16101	Fluid Machines	3	1	0	7
2.	MMC16104	Fluid Power and Control	3	1	0	7
3.	MMC16105	I C Engines and Turbo-machines	3	1	0	7
4.	MMC16111	Drilling Engineering	3	1	0	7
5.	MMC16112	Opencast Production Equipment	3	1	0	7
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC16201	Mechanical Engineering Lab. V	0	0	3	3
7.	MMC16202	Mechanical Engineering Lab. VI	0	0	3	3
8.	MMC16911	Industrial Training / Seminar *	0	0	0	(2)
9.	MMC16501	Composite Viva-Voce	0	0	0	(4)
<b>Total Credit Hours</b>			<b>15</b>	<b>6</b>	<b>6</b>	<b>48</b>

\* Industrial training performed after V-th Semester is to be credited in VI-th Semester

### SEVENTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	MMC17101	Measurements and Control	3	0	0	6
2.	MMC17102	Mechanical Vibration	3	1	0	7
3.	MMC17111	Bulk Solids Handling Equipment	3	1	0	7
4. & 5.		<b>Elective (any two)</b>	2×(3	0	0)	12
	MME17101	Industrial Tribology				
	MME17102	Mechatronics				
	MME17103	Waste Heat Utilization				
	MME17104	Advanced Manufacturing Systems				
	MME17105	Mechanical System Design				
	MME17106	Energy Conversion Equipment				
	MME17107	Automobile Engineering				
	MME17108	Knowledge Based Systems				
	MME17109	Machine Fault Diagnosis & Control				
	MSR17153	Operation Research				
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC17211	Mining Machinery Lab.	0	0	3	3
7.	MMC17401	Project & Seminar	0	0	6	6
8.	MMC17611	Industrial Training / Seminar *	0	0	0	(2)
9.	MMC17001	Vocational Training *	0	0	0	(5)
<b>Total Credit Hours</b>			<b>15</b>	<b>2</b>	<b>9</b>	<b>48</b>

\* Summer training performed after VI-th Semester is credited in VII-th Semester.

### EIGHTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
<b>THEORY</b>						
1.	MMC18101	Mechanical Handling Equipment	3	1	0	7
2.	MMC18111	Mineral Transport & Loading Equipment	3	1	0	7
3.	MMC18112	Underground Production Equipment	3	1	0	7
4. & 5.	<b>Elective (any two)</b>		2×(3	0	0)	12
	MME18101	Finite Element Analysis				
	MME18102	Maintenance Engineering				
	MME18103	Composite Materials				
	MME18104	Automation and Robotics				
	MME18105	Power Plant Engineering				
	MME18106	System Modeling and Simulation				
	MME18107	Noise Engineering				
	MME18108	Fracture Mechanics				
<b>PRACTICAL &amp; OTHERS</b>						
6.	MMC18401	Project and Seminar	0	0	6	6
7.	MMC18501	Comprehensive Viva-Voce	0	0	0	(4)
8.	MMC18611	Industrial Visit / Seminar	0	0	0	(2)
		<b>Total Credit Hours</b>	<b>15</b>	<b>3</b>	<b>6</b>	<b>45</b>

### CAPSULE COURSES (For Non-Departmental Students)

#### SIXTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
1.	MMR16101	Mining Machinery I	3	0	0	6

#### SEVENTH SEMESTER

Sl. No.	Course No.	Name of the Course	L	T	P	CH
1.	MMR17101	Mining Machinery II	3	0	0	6

# SYLLABUS FOR B.TECH in MECHANICAL ENGG.

## FIRST / SECOND SEMESTER

### MATHEMATICS – I

L – T – P : 3 – 1 – 0

**Calculus-I:** Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurin's expansion of functions of single variable.

Functions of several variables, partial derivatives, Euler's theorem, derivatives of composite and implicit functions, total derivatives, Jacobian's, Taylor's and Maclaurin's expansion of functions of several variables, Maxima and minima of functions of several variables, Lagrange's method of undetermined multipliers. Curvature and asymptotes, concavity, convexity and point of inflection. Curve tracing.

**Calculus-II:** Improper integrals, convergence of improper integrals, test of convergence, Beta and Gamma functions and its properties, Differentiation under integral sign; differentiation of integrals with constant and variable limits; Leibnitz rule.

Evaluation of double integrals, Change of order of integration, change of coordinates, evaluation of area using double integrals, Evaluation of triple integrals, change of coordinates, evaluation of volumes of solids and curved surfaces using double and triple integrals. Mass, center of gravity, moment of inertia and product of inertia of two and three-dimensional bodies and principal axes.

**Trigonometry of complex Number, 3D Geometry and Algebra:** Function of complex arguments, Hyperbolic functions and summation of trigonometrical series.

**3-D Geometry:** Cones, cylinders and conicoids; Central conicoids, normals and conjugate diameters.

**Algebra:** Convergence and divergence of Infinite series. Comparison test, D' Alembert's ratio test, Raabe's test, logarithmic test, Cauchy's root test. Alternating series; Leibnitz test, absolute and conditional convergence, power series, uniform convergence.

#### Reference Books:

1. Differential Calculus by B.C. Das and B.N.Mukherjee
2. Integral Calculus by B.C. Das and B.N.Mukherjee
3. Integral Calculus by R.K. Ghosh and K.C. Maity
4. Analytical Solid Geometry by Shanti Narayan
5. Text book of Engineering Mathematics by Debashish Dutta.

### MATHEMATICS – II

L – T – P : 3 – 1 – 0

#### Vector Calculus and Fourier Series:

**Vector Calculus:** Scalar and vector fields, Level surfaces, Differentiation of vectors, Directional derivatives, gradient, divergence and curl and their physical meaning, vector operators and expansion formulae, Line, surface and volume integrations, Theorems of Green, Stokes and Gauss, Application of vector calculus in engineering problems, orthogonal curvilinear coordinates, expressions of gradient, divergence and curl in curvilinear coordinates.

**Fourier Series:** Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Parseval's formula, complex form of Fourier series.

**Matrix Theory:** Orthogonal, Hermitian, skew-Hermitian and unitary matrices, Elementary row and column transformations, rank and consistency conditions and solution of simultaneous equations, linear dependence and independence of vectors, Linear and orthogonal transformations. Eigen values and Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to normal forms, quadratic forms, reduction of quadratic forms to canonical forms, index, signature, Matrix calculus & its applications in solving differential equations.

**Differential Equations:** Differential equations of first order and higher degree, Linear. independence and dependence of functions. Higher order differential equations with constant

coefficient, Rules for finding C.F. and P.I., Method of variation of parameter, and method of undermined coefficients, Cauchy and Legendre's linear equations.

Linear differential equations of second order with variable coefficients; change of dependent variable, change of independent variable, linear equations of special types; dependent variable absent, independent variable absent. Simultaneous linear equations with constant coefficients. Various applications of higher order differential equations in solution of engineering problems.

**Partial Differential Equations:** Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations, and Charpit's method. Homogeneous and non-homogeneous linear P.D.E. with constant coefficients. Rules for finding C.F. & P.I.

#### Reference Books :

1. Vector Analysis by Lalji Prasad
2. Theory and Problems of Advanced Calculus by M.R. Spiegel (Schaum Series)
3. Theory and Problems of Laplace Transform by M.R. Spiegel (Schaum Series)
4. Higher Engineering Mathematics by B.V. Raman.
5. Advanced Engineering Mathematics by R.K.Jain & S.R.K. Iyenger.
6. A Text Book of Matrices by Shanti Narayan

### PHYSICS

L – T – P : 3 – 1 – 0

**Thermal Physics:** Concepts of distribution of molecular velocities; Distribution laws and statistics – MB, FD and BE, mean free path; Transport phenomena-viscosity, diffusion; thermal conductivity, measurement of thermal conductivity; periodic and aperiodic flow of heat; Wiedemann-Franz law.

Heat radiation; black body and black body radiation; Planck's distribution law and its application to classical distribution (Rayleigh-Jeans and Wiens) and total radiation (Stefan-Boltzmann) laws.

**Modern Physics:** Brief idea of molecular spectra; Rigid rotator, spectra of simple molecules, rotation and rotation-vibration spectra. Brief idea of wave packet and wave function, Shrodinger equation, Particle in a Box. Free electron theory; qualitative idea of band theory of solids and Hall effect, Laser and laser systems He-Ne and Ruby Lasers).

**Electromagnetics and Electrical Phenomena in Rocks:** Maxwell's field equation, Equation of electromagnetic field, Propagation of electromagnetic waves in different isotropic media, energy of electromagnetic waves, Poynting's theorem and Poynting's vector. Rocks and minerals as dielectrics, electrical conductivity and electrical phenomena in rocks, Piezo-, ferro-, tribo-, and pyro-electricity.

### PHYSICS PRACTICAL

L – T – P : 0 – 0 – 3

Measurement of thermal conductivity of bad conductors, Optical experiments on Diffraction using diffraction grating. Experiments on Semi-conductors - measurement of band gap and Hall effect Experiments using He- Ne Laser - Diffraction Experiments to measure Brewster's angle & find refractive index.

#### Reference Books:

1. A Treatise on Heat – Saha and Srivastava
2. Engineering Physics – B.L.Theraja
3. Physics of Rock and Minerals – Rzhovsky & Novic
4. Lasers – Ghatak & Thyagarajan
5. Solid State Physics – C Kittel
6. Elements of Electromagnetic theory – M N O Sadiku



## CHEMISTRY

L – T – P : 3 – 1 – 0

**Cement:** Manufacturing, composition, setting and hardening of cement.

**Glass:** Types of Glasses, Manufacturing & properties of Glasses.

**Polymers:** Classification, structure - property relationship, conductive polymers.

**Solid Fuels:** Structure of coal, classification of coal, Effect of heat on coal, carbonization and pyrolysis; Recovery and purification of by-products obtained from coke ovens; Distillation of coal tar; coal chemicals.

**Liquid Fuels:** Composition of crude oil, processing of crude oil, distillation, sweetening and cracking (basic concepts), octane number, Cetane number; Additives to improve the quality of diesel and petrol, bio-diesel.

**Gaseous Fuels:** Characteristics of good fuel; calorific value, theoretical calculations of calorific value of a fuel, natural gas and hydrogen gas.

**Phase rule and phase equilibrium diagram:** Phase rule; degree of freedom, one and two component systems, temperature and composition diagrams, liquid-liquid and liquid-solid phase diagrams.

**Lubricants:** General characteristics of lubricants, chemistry of lube oil and greases; Reclamation of lubricants.

**Equilibrium:** Electrochemistry: Electric potentials at interfaces, electrodes, batteries, electrochemical cells and their applications.

**Corrosion:** Chemical and electrochemical corrosion, classification, factors affecting corrosion, Form of corrosion and general methods of corrosion prevention.

## CHEMISTRY PRACTICAL

L – T – P : 0 – 0 – 3

### List of Experiments

1. Standards of HCl by Standard Sodium Carbonate solution
2. Determination of Temporary Hardness of tap water.
3. Estimation of Total Hardness of water.
4. Determination of Iron in Ferrous Ammonium Sulphate solution (Redox titration).
5. Determination of Copper in crystallized Copper Sulphate.
6. Estimation of available Chlorine in Bleaching Powder.
7. Determination of Molecular Weight of Organic Acid by Titration method.
8. Estimation of Sodium Carbonate and bicarbonate in a mixture.
9. To determine the saponification number of an oil.
10. To determine the rate of hydrolysis of methyl and ethyl acetate.
11. To prepare Chrome Alum.

### **Reference Books:**

1. A Textbook of Engineering Chemistry-Sashi Chawla
2. Applied Chemistry: A Textbook for Engineers and Technologists - H.D.Gesser.
3. Engineering Chemistry - P.C.Jain & Monika Jain
4. Engineering Materials - K.G. Budinski & M K Budinski
5. Engineering Chemistry - B K Sharma

## ENGINEERING GRAPHICS

L – T – P : 1 – 3 – 0

Drawing instruments and their uses; Indian standards for drawing.

**Lettering; Types of lines used in engineering graphics:** Full lines hidden lines, dimension lines, centerlines, section lines construction lines etc.

**Scales:** Representative fractions, reducing and enlarging scales, plain scales, diagonal scales and vernier scales.

**Curves used in engineering practice:** Conic sections, ellipse, parabola, hyperbola, cycloid, epicycloid, hypocycloid, involutes and spiral.

**Orthographic projections:** First angle and third angle projections, conventions used, orthographic projection of simple solids; Conversion of three-dimensional views to orthographic views.

**Isometric projections:** Isometric projection of simple solids, isometric views, conversion of orthographic views to isometric views.

**Free hand sketching.**

#### Reference Books:

1. Engineering Drawing - N D Bhatt
2. Engineering Graphics - S C Sharma & Naveen Kumar
3. Engineering Drawing - P S Gill
4. Engineering Drawing with Auto-CAD - Parvez, Khan & Khalique

### MANUFACTURING PROCESSES

L – T – P : 1 – 3 – 0

**Carpentry:** Classification of timber, seasoning and preservation of wood, description and applications of the various tools used in carpentry, different joints and their practical uses.

**Forging:** Introduction to Forging, types of tools and their uses, colour representations of different temperature levels, recrystallisation, workability of metals at elevated temperature, safety rules.

**Casting:** Introduction to foundry, Pattern making, types of casting processes, purpose of runner & riser, applications of casting, defects in casting.

**Fitting:** Introduction to fitting jobs, fitting tools and their uses, safety rules.

**Welding:** Welding types, accessories, weldments, and safety rules.

**Machine Tools:** Types of tools, Types of Machine Tools and their specifications, safety rules.

**Measurement:** Use of vernier etc for product measurement.

#### Reference Books:

1. Workshop Technology Part I, II & III - W A J Chapman
2. Workshop Technology Part I & II - Hazra Chowdhury
3. Workshop Technology Part I & II – Raghubanshi

### ELECTRICAL TECHNOLOGY

L – T – P : 3 – 1 – 0

**Network theorems** (KCL, KVL, Thevenin, Norton, Maximum power transfer) applied to steady-state DC circuit. Single-phase AC circuits and phasor diagrams, series and parallel resonance. Three-phase AC circuits with balanced and unbalanced loads, phasor presentation, measurement of three-phase power by two-wattmeter method.

**Single-phase transformer:** Construction, types, EMF equation, equivalent circuit, phasor diagram, regulation, efficiency, OC and SC tests.

**DC Machines:** Construction, types, principle of operation, EMF and torque equation.

**DC generator:** OCC and external characteristic curves and efficiency.

**DC motors:** speed-torque characteristics, starting, 3-point starter, speed control and efficiency.

**Three-phase induction motor:** Construction, types, principle of operation, torque-slip characteristics, starting methods.

**Introduction to three-phase synchronous motor.**

### ELECTRICAL TECHNOLOGY PRACTICAL

L – T – P : 0 – 0 – 3

Experiments on Thevenin's theorem, R-L-C series circuit, Single phase power measurement, Characteristics of fluorescent lamp and incandescent lamp, OC and SC tests of single phase transformer, Open-circuit characteristics of DC separately excited generator, External

Characteristics of separately excited DC generator, Three-point starter of DC shunt motor, Speed control of DC motor.

**Reference books:**

1. Electrical Engineering Fundamentals - V Del Toto
2. Basic Electrical Engineering (Special Indian Edition) - J J Cathey, S A Nasar, P Kumar.
3. Hughes Electrical and Electronic Technology - E Hughes, I M Smith, J Hiley, K Brown.
4. Basic Electrical Engineering - D P Kothari and I J Nagrath.
5. Electric Machinery - A E Fitzgerald, C Kingsley, S D Umans.

**ELECTRONICS ENGINEERING**

L – T – P : 3 – 1 – 0

**Semiconductor Diodes and Applications** - Introduction Characteristics, dc and ac resistances of a diode. Half wave and Full wave rectification. Zener Diodes and then use as regulators, Clippers and Clampers.

**Bipolar Junction Transistor** - Introduction, Transistor operation CB, CE and CC configuration, dc Biasing, Operating Point, Fixed Bias Circuit, Emitter - Stabilized Bias Circuit. Voltage Divider Bias.

**BJT Transistor** - Amplification in ac domain, Equivalent transistor model. Hybrid Equivalent model, RC coupled amplifier and its frequency response.

**Operational Amplifiers** - Introduction, Differential and Common Mode Operation, OP AMP Basics, Practical OPMAP Circuits.

**Introduction to Field Effect Transistors and their applications.**

**Digital Electronics** - Review of Basic Gates and Boolean Algebra, Introduction to Combinational Logic Design. Standard Representations of Logical Functions and their simplification. Combinational Logic Design, Half Adder and Full Adders.

**Sequential Circuits** - Flip flops S-R, J-K and D Application in Ripple Counters.

**Reference Books:**

1. Electronic Device and Circuit Theory - Boylestad & Nashlesky
2. Digital Principles & Applications - Malvino & Leach

**ELECTRONICS ENGINEERING PRACTICAL**

L – T – P : 0 – 0 – 3

1. Study of Electronic Equipment & Components.
2. Study of diode characteristics.
3. Study of regulated power supply.
4. Study of BJT characteristics.
5. Study of op-amp characteristics.
6. Implementation of Boolean algebra using logic gates.
7. Adder Circuits.
8. Flip Flops.

**ENGINEERING MECHANICS**

L – T – P : 3 – 1 – 0

**Fundamentals of Mechanics:** Equivalent force system, Equation of equilibrium, Introduction to Structural mechanics: Force analysis of Frames, Trusses, Shear force, bending moment analysis of Beams.

**Friction force analysis:** Laws, Sliding and Rolling friction, Screw Jack, Wedge, Belt friction, Collar friction.

**Properties of surfaces:** First moment of area and the centroid, Second moment and product of areas, Transfer theorem, Polar moment of inertia.

**Introduction of variational mechanics,**

**Kinematics of particles:** Velocity and acceleration calculations, Relative motion. Particle dynamics: Rectilinear translation, Rectangular and cylindrical coordinates. Energy methods: Conservation of mechanical energy, work-energy equations.

**Linear momentum and moment of momentum:** Impulse and momentum relations for a particle, Moment of momentum equations for a single particle and for a system of particles.

**Introduction to kinematics and kinetics of rigid bodies.**

**Mechanical vibration of single degree of freedom system.**

**Reference Books :**

1. Vector Mechanics for Engineers - Statics & Dynamics: Beer, Johnston.
2. Engineering Mechanics - Statics & Dynamics: Nelson, Best, McLean.
3. Engineering Mechanics - Statics & Dynamics: Shames, Rao, Pearson.
4. Engineering Mechanics - K.L.Kumar.
5. Engineering Mechanics - Statics & Dynamics: A.K.Tayal.

**ENGLISH FOR SCIENCE AND TECHNOLOGY**

L – T – P : 3 – 1 – 0

**Language Resource Development:** Using appropriate grammatical lexical forms to express meaning-accuracy, range and appropriacy grammatical lexical exercises.

**Reading, Interpreting and Using Written, and Graphic Information:** Using (reading and writing) academic texts, articles in technical journals, instruction manuals/laboratory instruction sheets, safety manuals and regulations, and reports; Using maps, graphs, plan diagrams, flow-charts, sketches, tabulated and statistical data.

**Writing Appropriately in a Range of Rhetorical Styles i.e. Formal and Informal:** Writing instructions, describing objects and processes; defining, narrating, classifying exemplifying, comparing, contrasting, hypothesizing, predicting, concluding, generalizing, restating and reporting; Note making (from books/journals); Writing assignments; summarizing, expanding, paraphrasing; Answering examination questions; Correspondence skills; Interpreting, expressing and negotiating meaning; Creating coherent written texts according to the conventions.

**Receiving and Interpreting the Spoken Word:** Listening to lectures and speeches, listening to discussions and explanations in tutorials; Note taking (from lectures); Interacting orally in academic, professional and social situation; Understanding interlocutor, creating coherent discourse, and taking appropriate turns in conversation; Negotiating meanings with other (in class room, workshop laboratory, seminar, conference, discussion, interview etc.).

**Reference Books:**

1. Using English in Science and Technology - R K Singh
2. Practicing English in Science and Technology - R K Singh
3. Communication in English: Grammar and Composition - R K Singh
4. Communication in English for Technical Studies - William, Ray; Ray Rabindranath; and Swales, John-Orient Longman

**EARTH SYSTEM SCIENCE**

L – T – P : 3 – 0 – 0

AGL (2 – 0 – 0)

**Space Science:** Solar System, Age of the Earth, Origin of Solar system. Meteors and Meteorites.

**Earth Dynamics:** Interior of the Earth, Composition of the Earth, Seismic waves, Seismograph, Plate Tectonics, Basics of Earthquake, Landslides, Volcanoes.

**Geological Oceanography:** Sea waves, Tides, Ocean currents, Geological work of seas and oceans, Tsunami and its causes, Warning system and mitigation.

**Hydrogeology:** Water table, Aquifer, Groundwater fluctuations and groundwater composition, Hydrologic cycle.

**Glaciology:** Glacier types, Different type of glaciers, Landforms formed by glacier.

**Geological bodies and their structures:** Rock, Mineral, Batholith, Dyke, Sill, Fold, Fault, Joint, Unconformity

CME (1 – 0 – 0)

**Earth's Atmosphere:** Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and global warming, Carbon dioxide sequestration. Steps to maintain clean and pollution free atmosphere with governing laws, precautionary measures against disasters.

**Biosphere:** Origin of life, Evolution of life through ages, Geological time scale, Biodiversity and its conservation.

**Natural Resources:** Renewable and non-renewable resources, Mineral and fossil fuel resources and their geological setting; Mining of Minerals and conservation, Effect of mining on surface environment.

**Reference Books:**

1. Earth System Science from bio-chemical cycles to global changes: Jacobson, M., Charlson, R.J., Rodhe, H., and Orians, G.H., 2002,
2. Fundamentals of Geophysics - Lowrie, W.
3. Earth System Science Education for the 21st Century: (<http://esse21.usra.edu>)
4. Earth's Dynamic Systems – W Kenneth and Eric H Christiansen.
5. Exploring Earth: An introduction to Physical Geology - John P Davidson.
6. Holmes Principles of Physical Geology - A. Holmes
7. A Textbook of Geology – P K Mukherjee.
8. A Text book of Environmental Studies for Undergraduate Courses - Erach Bharucha.

**GLOBAL ENERGY SCENARIO AND ENERGY SECURITY OF INDIA**

L – T – P : 3 – 0 – 0

Definition of energy; Primary & secondary energy; Difference between energy, Power & electricity;

Renewable and Non-Renewable Sources of Energy; The concept and Significance of Renewability; Social, Economic, Political and Environmental Dimension of Energy;

Major Types and Sources of Energy at the Global and at the National Level;

Global and Indian Reserves and Resources of Natural Oil and Gas, Coal and Nuclear Minerals:

Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based Power and Energy: Globally and in India;

Energy Sources and Power Generation: Thermal, Nuclear, Hydroelectric, Solar, Wind and Wave; General Principles; Relative Merits and Demerits including, Conversion Efficiency, Generation Cost and Environmental Impact: Concepts of Open and Combined Cycles, Co-generation: Clean Coal Initiatives; Power Transmission and Distribution: General principles; Demand-side management; Social, Political, Economic and legal issues involved in the generation, transmission distribution of power in India.

Current Scenario and Future Prospects of Carbon Sequestration, Coal Gasification and CBM.

Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells;

Energy cum Power Scenario of India vis-a-vis China, South Africa and the USA; Global Energy Politics.

**Reference Books:**

1. Non-Conventional Energy Sources, G.D. Rai
2. A Textbook of Power Plant Engineering, R.K. Rajpur
3. World Coal Institute Website.
4. Uranium Information Center Website.
5. World Energy Council Website.
6. Integrated Energy Policy, GOI.

## COMPUTER PROGRAMMING

L – T – P : 3 – 0 – 0

Introduction to Computer Software.

Introduction to Programming, Data Types, Variables, Operators and Expressions, Assignments, Input/ Output, Control statements and iterations, Arrays and subscripted variables, String manipulation, Functions, Recursions, Structures and unions, Pointers, Dynamic memory allocation, Linked structure, File handling, Language preprocessor and Command line arguments. Introduction to Object Oriented Programming in C++ .

### Reference Books:

1. The C Programming Language - Brain W. Keringhan and Dennis M Ritchi
2. Programming in ANSI C - E. Balaguruswamy
3. Schaum's Outline of Programming with C - Byron Gottifried.
4. Fundamentals of Data Structures in C - Ellis Horowitz, S Sahni and Susan Anderson-Freed
5. Object Oriented Programming in C++ - E.Balaguruswamy
6. Object Oriented Programming in C++ - Robert Lafore

## VALUE EDUCATION, HUMAN RIGHTS AND LEGISLATIVE PROCEDURE

L – T – P : 3 – 1 – 0

Social Values and Individual Attitudes, Work Ethic, Indians Vision of Humanism, Moral and Non-moral Valuation, Standards and Principles, Value Judgments.

Rural Development in India, Co-operative Movement and Rural Development.

Human Rights, UN declaration, Role of various agencies in protection and promotion of Rights.

Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive, and Judiciary: Their Composition, Scope and Activities.

The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of the States, Composition of the House of the People, Speaker,

Legislative Procedure: Ordinary Bills, Money Bills, Private Members Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/Governor.

Vigilance: Lokpal and Functionaries.

### Reference Books:

1. An Introduction to Ethics - Robert E. Dewey and Robert H. Hurlbutt III
2. Introduction to the Constitution of India - Durga Das Basu
3. Essay and Reflections - Sarvapalli Radhakrishnan, Mahatma Gandhi
4. An Autobiography :The story of My Experiments with Truth – M K Gandhi,
5. Human Rights: Questions and Answers - Leah Levin

### **THIRD SEMESTER**

#### **MMC 13101 -- MECHANICS OF MATERIALS I (3 — 1 — 0)**

Basic concepts of mechanics of materials: stress strain behavior of engineering materials.  
Concept of stress and strain field, stress-strain transformation, Hook's law and compatibility conditions  
Mohr's circle representation for plane stress and plane strain, thermal stresses and strains, volumetric stress and strain  
Stresses in pressure vessels: thin, thick and compound cylinders.  
Beam Analysis: stresses in beams, deflection in beams, statically indeterminate beam analysis.  
Strain energy concept for structural members  
Torsion of circular members and thin walled tubes  
Combined stresses and strains in structural members  
Springs: Helical and Leaf springs,  
Failure theories; Buckling of columns; Concept of creep, fatigue and fracture.

#### **References:**

1. Strength of Materials: Part I, II, S. Timoshenko, CBS Publishers, 1985.
2. Engineering Mechanics of Solids, E. P. Popov, EEE/PHI, 1993.
3. Introduction to Solid Mechanics, I. H. Shames and J. M. Pittarresi, EEE/PHI, 2003.
4. Mechanics of Materials, F. P. Beer, E. R. Johnston, Jr. & J. T. DeWolf, TMH, 2004.

#### **MMC13102 -- ENGINEERING THERMODYNAMICS (3—1—0)**

**Basic Thermodynamics:** Macroscopic and microscopic viewpoint of thermodynamics, Thermodynamic system, control volume, properties, processes and cycles, Thermodynamic equilibrium, concept of continuum, Work and heat transfer, First Law of Thermodynamics applied to closed and open systems, Enthalpy, Second Law of Thermodynamics, Entropy, Carnot's Theorem, Carnot's propositions, Clausius inequality and entropy principle.  
Available energy, Availability and irreversibility.  
Properties of pure substances  
**Applied Thermodynamics:** Steam generators: Classification, construction, mountings, accessories, its functions and performance.  
Different thermodynamic cycles: Air standard cycle, vapour power cycles, Refrigeration cycles and Gas turbine cycles  
Principle of working of 2-S and 4-S internal combustion engines.

#### **References:**

1. Engineering Thermodynamics - P.K. Nag
2. Engineering thermodynamics, Van Wylen, R. E. Sonntag & C Borgnakke
3. A Course in Internal Combustion Engines - M.L.Mathur & R.P.Sharma
4. Engineering Thermodynamics - Kothandaraman & Domkundwar

#### **MMC13103 -- KINEMATICS OF MACHINES AND MECHANISMS (3--1--0)**

Kinematic pairs, diagram and inversion, mobility and range of movements.  
Displacement, velocity and acceleration analysis of planar linkages.  
Dimensional synthesis for motion, function and path generation, Devis and Ackermann steering mechanisms, Hooke's joint.  
Cam profile synthesis.  
Types of gears, motion and synthesis of simple, reverted and planetary gear trains.  
Brakes, clutches and dynamometers.

### **References:**

1. Mechanism and Machine Theory by J.S.Rao and R.V. Dukkipati, New Age International
2. Theory of Machines and Mechanisms by J.J. Shigley and J.J.Uicker, McGrawhill
3. Theory of Machines by S.S. Ratan, Tata McGraw-Hill, New Delhi
4. Theory of Mechanism and Machine by A. Ghosh and A.K. Mallik, East West Press (Pvt.) Ltd., New Delhi

### **MMC13104 -- COMPUTER GRAPHICS & GEOMETRIC MODELING (3--1--0)**

**Computer Graphics:** Introduction to computer graphics, Graphics display devices, Introduction to interactive computer graphics, Locators and Valuators, Window, View port, Hidden line removal, Hidden surface removal, Graphics user interface, Introduction to OpenGL, Shading, Clipping, Z-buffer, transparency, Two dimensional geometric and co-ordinate transformation, translation, rotation, scaling, mirror reflection, inverse co-ordinate transformation, Matrix description of basic transformation. Graphics coordinate system.

**Geometric Modeling:** Parametric curves, Hermite Curves, Bezier curves, B-spline curves, Rational and non-rational curves, parametric surfaces, Hermite surface, Bezier, surface, B-Spline surface, Intersection of curves and surfaces, interpolation of curves and surfaces. Properties of curves and surfaces, Wire frame modeling and STL files.

### **References:**

1. Procedural Elements for Computer Graphics, D. F. Roger, McGraw Hill International Editions.
2. Mathematical Elements of Computer Graphics, D. F. Roger and J. A. Adam, McGraw Hill Publication.
3. Geometric Modeling, M. E. Mortenson, Industrial Press In., New York.
4. Curves and Surfaces for Computer Aided Geometric Design, G. Farin, Academic Press, New York.

### **AMR 13101 -- METHODS OF APPLIED MATHEMATICS I (4--1--0)**

**Section A: Analysis of Complex variables:** Limit, continuity and differentiability of function of complex variables, Analytic functions, Cauchy-Riemann's and Cauchy's Integral theorem, Morera's theorem, Cauchy's integral formula, Expansion of function of complex variables in Taylor's and Laurent's series, singularities and poles. Residue theorem, contour integration, conformal mappings and its application, Bilinear Transformation.

**Section B: Special Functions:** Solution in series of ordinary differential equations, solution of Bessel and Legendre equations, recurrence relations and generating function for  $J_n(x)$ , orthogonal property and Integral representation of  $J_n(x)$ . Legendre polynomial, Rodrigue formula, orthogonality properties and generating function for  $P_n(x)$ . Elliptic integrals and error function and their properties.

**Section C: Laplace Transform and PDE:** Laplace Transform of simple functions, first and second shifting theorems, t-multiplication and t-division theorems; Laplace transforms of derivatives, integrals and periodic functions. Inverse Laplace transform and convolution property. Use of Laplace transform in evaluating complicated and improper integrals and solution of ordinary differential equations related to engineering problems.

**Partial Differential Equations:** Classification of Partial Differential Equations, solutions of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation in Cartesian and polar coordinates by variable separable method with reference to Fourier trigonometric series and by Laplace transform technique.



## **MMC 13201 -- MECHANICAL ENGINEERING LABORATORY I (0 -- 0 -- 3)**

Any six will be conducted out of the following experiments.

1. Tension test
2. Compression Test
3. Torsion Test
4. Beam Bending Test
5. Impact test
6. Hardness test
7. To study construction and operation of various engine models.
8. To study construction and operation of various boiler models.
9. To study the different inversions of slider-crank mechanisms
10. To study the Coriolis component of acceleration.
11. Plotting of follower motion for different cam profiles.

## **MMC 13301 -- MACHINE DRAWING (S) (1 – 5 – 0)**

Projection of points, lines and planes: Projection of lines and planes to auxiliary planes, True lengths of lines and true shapes of planes.

Projection and section of solids to various planes and true shapes of sectioned surface; Inter-penetration of solids and their projections; surface development of solids and its uses.

Standard conventions for section of machine components.

Drawing of simple nuts and bolts, keys, cotters, pins. Assembly drawing of simple machine parts like bearings, couplings, valves etc.

## **FOURTH SEMESTER**

### **MMC14101 -- FLUID MECHANICS I (3 – 1 – 0)**

Properties of fluids: Viscosity; Unit, Newton's law of viscosity, viscosity variation with temperatures; measurement of viscosity.

Pressure and its measurement: Absolute, gauge, atmospheric and vacuum pressures; manometers and mechanical gauges.

Hydrostatic force and surfaces; total pressure and center of pressure for plane, inclined and curved submerged surfaces; pressure on lock gates.

Kinematics: Types of fluid flow, rate of flow, continuity equation in three dimension, velocity potential and stream function; free and forced vortex flow.

Dynamics: Equation of motion, Euler's and Bernoulli's equations and their practical applications; venturimeter, orifice meter, pitot tube, momentum equation and moment of momentum.

Flow through orifices: Introduction, classification of orifices, concept of  $C_c$ ,  $C_v$  and  $C_d$ .

Flow through notches: Introduction, classification of notches - rectangular, triangular, trapezoidal and stepped notches, concept of velocity of approach.

Flow through pipes: Loss of energy in friction, Darcy's and Chezy's equations, minor losses; Hydraulic gradient and total energy line, pipes in series and parallel, equivalent pipe, power transmission through pipes and nozzles.

Compressible flow: Equation of state, continuity equation and Bernoulli's equation, velocity of sound wave in fluid, Mach number.

Viscous flow: flow through pipes, flow between two parallel plates; Kinetic energy and momentum correction factor.

Impact of jets: Force exerted by a jet on stationary, hinged and moving plates; jet propulsion.

**References:**

1. Fluid Mech. through problems – R J Garde
2. Hyd. & Fluid Mech. – J. Lal
3. Fluid Mech. – Streeter & Wilie
4. Fluid Mech. – I H Shames
5. Fluid Mech – Som and Biswas
6. Fluid Mech. and Fluid Power Engg. – D.S. Kumar

**MMC 14103 – MECHANICAL ENGINEERING DESIGN I (3—3—0)**

Introduction, Various classifications of Machine design, General considerations of Machine Design.

Selection of materials: classification, mechanical properties and application of Ferrous, Non-Ferrous metals and their alloys, Non-Metallic materials, Powdered materials, Composite materials and ceramics.

Designing for Strength: Different types of loading on machine members & associated stresses, factor of safety & design stress, stress concentration, Design for simple and combined loading, choice of theory of failures, Effect of temperature, design considerations for varying loads, Endurance limit, Mechanism of Fatigue failure and associated factor of safety by different methods. Combined steady and variable loads.

Joints: Classification, integrity and uses of different type of permanent and detachable joints, design procedures for Riveted, Welded, Threaded, Cotter, Knuckle and interference joints.

Design and Selection of different components of Power Screw, Levers and Links.

Shafts & Axles: Design for steady, combined and fluctuating loads, rigidity and critical speed considerations in shaft design.

Classification and design of Keys, Splines and Couplings.

Mechanical Drives: Classification and selection steps for main components of belt, rope and chain drives.

Classification, application and design consideration of springs, clutches and brakes.

Design consideration under eccentric loading: Wall brackets, hangers and base plate joints of pillar cranes.

**References:**

1. Machine Design, V. L. Maleev and J. B. Hartman.
2. Mechanical Engineering Design, J. E. Shigley, Mischke & R. Charles.
3. Design of Machine Elements, M. F. Spotts & T. E. Shamp.
4. Machine Design, Robert L. Norton.
5. Design Data Hand Book, PSG College of Technology.
6. Relevant Indian Standards.

**MER 22132 – MINING METHODS & UNIT OPERATIONS (3—0--0)**

Surface mining: Deposits amenable to surface mining; Box cut: objectives, types, parameters and methods; Production benches - objectives, formation and bench parameters; Unit operations and associated equipment; Classification of Surface Mining Systems.

Underground coal mining: Deposits amenable to underground coal mining; Classification of underground coal mining methods; Bord and pillar methods – general description and applications and merits and demerits; Selection of panel size, operation involved and associated equipment; Longwall methods – Types and their general description, applicability, merits & demerits; Selection of face length & panel length, operations involved and associated equipment; Methods for mining steeply inclined seams and thick seams; Hydraulic mining.

Underground metal mining: Deposits amenable to underground metal mining; Shape, size & position of drifts & cross cuts; Raises & Winzes; Classification of underground metal mining methods; Stopping methods – general description, applicability, operations involved and associated equipments for room and pillar mining, Stope & Pillar mining, shrinkage stoping, sub-level stoping, cut & fill stoping, VCR methods, Sub-level caving & Block caving.

**References:**

1. Mining, Boky
2. Coal Mining Practices, Statham.
3. Longwall Mining, Syd S. Peng and H. S. Chiang.

**EER 14101 -- APPLIED ELECTRICAL ENGINEERING (3—1—0)**

Operation and characteristics of three-phase Induction motors; Methods of starting & speed control of three phase induction motor; Ward-Leonard method of speed control of DC motor; Basic principles of Thyristor controlled variable speed DC and AC motors.

Principles of rate making of electricity and power factor improvement; Substation arrangement; Circuit breakers; Protective relays: - Induction pattern over current relay, thermal overload relay, earth fault relay, Lightning Arrester, Fuses: - types and selection.

Power cables: - Types & selection, Types of motor enclosure, FLP enclosures for hazardous area equipment, Intrinsically safe circuit.

Industrial application & control of electrical motors: - Types of electric motors and their application in Industry; Controller for the speed control of DC & AC motors.

Diesel – Electrical oil rigs. I.E rules applied to mines & oil fields.

**References:**

1. A text book on power system engineering, Soni, Gupta, Bhatnagar, Chakrabarti.
2. Electrical Machines, Nagrath and Kothari.
3. Electrical Drives, G. K. Dubey.

**AMR 14101 -- NUMERICAL AND STATISTICAL METHODS (4—0—0)**

**A. Numerical Methods**

Solution of algebraic and transcendental equations by bisection. Iteration, false position, secant and Newton Raphson methods, Generalized Newton's method for multiple roots.

Solution of a system of linear simultaneous equations by Gauss elimination. Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss Seidel methods, Finite differences, Symbolic relations, differences and factorial notation of a polynomial, data smoothing, interpolation and extrapolation, Newton-Gregory forward and backward, Gauss forward and backward, Stirling, Bessel, Everett, Lagrange and Newton's divided difference formulae, Inverse interpolation by Lagrange and iterative methods, Cubic splines, Numerical differentiation and integration, Trapezoidal, Simpson's 1/3<sup>rd</sup>, Simpson's 3/8<sup>th</sup>, Weddle and Gaussian quadrature formulae.

Numerical solution of first order ordinary differential equation by Taylor's series, Picard's, Euler's, Modified Euler's, Runge-Kutta, Adams-Moulton and Milne's methods. Solution of simultaneous first order and second order ordinary differential equations with initial conditions by Taylor's series, Runge-Kutta and Milne's methods. Numerical solution of boundary value problems by finite difference and shooting methods.

**B. Statistical Methods**

Concept of a frequency distribution: Moments, skewness and kurtosis.

Probability: various approaches of probability-classical, frequency (statistical), subjective and axiomatic. Theorems on probability, conditional probability, independence, Bayes theorem.

Random variable-discrete and continuous. Distribution function and their properties, probability mass and density functions, Mathematical expectation, Moment generating function and its properties.

Probability distributions: Bernoulli, binomial, negative binomial, Poisson and normal distributions.

Theory of least squares and curve fitting.

Correlation: simple, multiple and partial, Regression lines and regression coefficients, multiple and partial regression coefficients, multiple and partial regression.

Tests of significance: Normal test, t-test, Chi-square and F-test.

### **MMC 14201 -- MECHANICAL ENGINEERING LABORATORY II (0 -- 0 -- 3)**

Any six will be conducted out of the following experiments.

1. Verification of Bernoulli's theorem.
2. Calibration of Venturimeter.
3. Flow through pipes.
4. Calibration of a V-notch.
5. Calibration of a circular orifice.
6. Study of different types of gear and gear trains.
7. Study of rope brake dynamometer.
8. Study of different types of couplings
9. Study of multiple clutches.

### **AMR 14201 -- NUMERICAL AND STATISTICAL METHODS (0 -- 0 -- 3)**

#### **Section – A: Numerical Methods (Practical): 50 (marks)**

Computer programming of the following in FORTRAN:

i) N-R method, ii) Iteration method, iii) Method of false position, iv) Lagrange's interpolation formula, v) Trapezoidal, Simpson's and Weddle's rules, vi) Gauss elimination method, vii) Gauss Seidel method, viii) Euler's and modified Euler's methods, ix) Runge-kutta and Milne's methods, x) Laplace's equation and xi) Heat conduction and wave equations.

#### **Section – B: Statistical Methods (Practical): 50 (marks)**

Computation of raw moments, central moments, coefficient of variation, coefficients of skewness and kurtosis, Fitting of straight line, second degree polynomial (parabola), power curve and exponential curve, computation of product moment correlation, multiple and partial correlation coefficients; Regression coefficients and regression lines, application of tests of significance based on numerical data.

## **FIFTH SEMESTER**

### **MMC 15101 – DYNAMICS OF MACHINERY (3—1—0)**

Static force analysis, free-body diagram, condition of equilibrium.

Dynamic force analysis, shaking effect.

Dynamics of reciprocating and rotary machines.

Balancing of reciprocating and rotary machines.

Cam dynamics, analysis of disc cam with reciprocating roller follower, analysis of elastic cam system, jump phenomenon.

Rigid body dynamics, Governors and Gyroscopes.

Introduction to Free and Forced Vibrations.

### **References:**

1. Theory of Machines and Mechanisms, Joseph E. Shigley, John J. Wicker, McGraw hill & Co.
2. Kinematics and Dynamics of Planar Machinery, Burton Paul, Prentice Hall Inc.
3. Theory of Machines, W. G. Green, Blackie & Sons.
4. Shock and Vibration Handbook, C. M. Harries, McGraw hill & Co.

### **MMC 15103 -- PRODUCTION TECHNOLOGY I(3--1--0)**

**Introduction:** Importance of manufacturing economics & technological considerations in manufacturing, Survey of manufacturing processes,

**Metal Forming Processes:** Elastic & plastic deformation, yield criteria, hot working vs. cold working, Load required to accomplish metal forming operation.

Analysis of important forming processes (forging process with sliding friction, sticking friction and mixed condition for slab, Work required for forging, Wire/strip drawing and max. reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling, Rolling mills)

**Sheet Metal working:** Die & punch assembly and press work methods and processes, Cutting mechanism, blanking vs. piercing, compound vs. progressive die, flat face vs. inclined face punch. Lubrication and defects in metal forming processes.

**Unconventional Metal forming processes:** Unconventional metal forming processes such as explosive forming, electro-magnetic, electro-hydraulic forming.

**Casting (Foundry):** Basic principle & survey of casting processes, Types of patterns and allowances, types and properties of moulding sand, Elements of mould and design consideration, gating system, riser, runners, core, Solidification of casting, theory and analysis, Sand casting, Die casting, centrifugal casting, Investment casting. Defects & remedies and inspection, melting practices (Cupola furnace).

**Powder Metallurgy:** Powder metallurgy manufacturing process, advantages and applications.

**Heat Treatment:** Different heat treatment processes and their applications

### **References:**

1. Materials and Processes in Manufacturing, Degarmo, J. T. Black, Prentice Hall of India Pvt Ltd.
2. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Prentice Hall.
3. Fundamentals of modern manufacturing processes, M. P. Groover.

### **MMC 15104 – MECHANICAL ENGINEERING DESIGN II (3—3—0)**

Introduction to the design process and probabilistic approach to design.

Manufacturing considerations in machine design: Standardization, Interchangeability, Preferred fits using basic hole system, Dimensions and Tolerances, Tolerances and Manufacturing methods, Surface roughness, Preferred Numbers.

Design of Flywheel, Pulleys, C-clamp and Crane hooks.

Design for strength and selection steps for Spur, Helical, Bevel and Worm Gears.

Design steps for fixed and variable speed gearboxes, Gear Box Lubrication.

Bearings: Classification, application and selection steps for sliding contact and rolling element bearings, Lubricants and lubrication of bearings.

Design of hand operated and powered Winches.

Seals and Gaskets: Classification, material and uses of static, dynamic, Labyrinth, oil and mechanical face seals.

Design of IC engine components like piston rod, connecting rod and crankshafts.

Introduction to the Computer Aided Design.

**References:**

1. Machine Design, V. L. Maleev and J. B. Hartman.
2. Mechanical Engineering Design, J. E. Shigley, Mischke & R. Charles.
3. Design of Machine Elements, M. F. Spotts & T. E. Shamp.
4. Machine Design, Robert L. Norton.
5. Design Data Hand Book, PSG College of Technology.
6. Relevant Indian Standards.

**EER 15101 -- MINE ELECTRICAL ENGINEERING (4—0—0)**

Transmission and Distribution of Electrical Power in Mines: Performance of short transmission lines; radial and ring – main distribution systems, substation arrangements for opencast and underground mines, distribution of electrical power in mines, mining type cable.

Mining type switchgears and protective devices: Types of circuit breakers, Gate end box, Drill panel, and Tran switch, Field Switch.

Symmetrical faults and circuit breaker rating calculation.

Protective relays – thermal and induction disc type overload relays; mining type earth fault relay.

Signaling and communication: Haulage and Coal face signaling systems for underground coal mines, basic concept of underground mine communication.

Power Economics: Types of industrial tariffs, power factor improvement in mines.

Electrical drives and Power Semiconductor Controller: Selection of motors and starters for mining applications; introduction to power semiconductor devices, basic principles of operation of thyristor controlled variable speed mine electrical drives, electrical braking.

Electrical Safety in Mines: Neutral Grounding and Equipment earthing practice in mines, principles of flameproof enclosure, intrinsic safety, Indian Electricity Rules as applied to mines – main provisions. Mine Lighting system.

**References:**

1. A text book on power system engineering, Soni, Gupta, Bhatnagar, Chakrabarti.
2. Coal Mining Practice [Vol – III], Statham
3. Electrical Equipment in Mines, H. Cotton.
4. Electrical Drives, G. K. Dubey.

**MSR 15152 -- INDUSTRIAL ENGINEERING & MANAGEMENT (3—0—0)**

Basic functions of management – planning, organizing, staffing, directing and controlling.

Introduction to industrial Engineering techniques.

Productivity: definition, measurement.

Work study and its role in improving productivity of an organization.

Types of Production systems.

Introduction to production planning and control.

Concepts of human resource management – selection, training and development.

Finance management – capital budgeting techniques, pay back period, ARR, NPV, IRR, PI; Sources of capital; Costs concepts and Break even analysis.

Project management – Introduction, Network construction & identification of critical activities in CPM & PERT.

**References:**

1. Essentials of Management, Koontz and O'Donne.
2. Finance Sense, Prasanna Chandra
3. Industrial Management, M E Thukaram Rao.
4. Work Study, I.L.O.
5. A Management Guide to PERT/CPM, J D Wiest and F K Levy.

### **MMC 15201 -- MECHANICAL ENGINEERING LABORATORY III (0 -- 0 -- 3)**

Any six will be conducted out of the following experiments.

1. Test on Heat Exchangers
2. Conduction Heat transfer test
3. Convection Heat transfer Test
4. To study the jump phenomena of Cam and Follower
5. Verification of Gyroscopic couple with the help of motorized Gyroscope.
6. To study the dynamics of governor.
7. To study the critical speed of rotating shaft.
8. Static and dynamic balancing of multi rotor system.
9. Static and Dynamic balancing of a rotor on dynamic balancing machine.

### **MMC 15202 -- MECHANICAL ENGINEERING LABORATORY IV (0 -- 0 -- 3)**

Any six will be conducted out of the following experiments.

1. Welding Process Test
2. Test on Profile Cutting
3. Test on Casting Processes.
4. To carryout different smithy operations.
5. Test on TIG/MIG Welding.
6. Test on Plasma and Gas cutting.
7. Test on Surface Measurement
8. Test on Gear Measurement
9. Test on Taper Measurement

## **SIXTH SEMESTER**

### **MMC 16101 -- FLUID MACHINES (3 – 1 – 0)**

Classification and field of application of fluid machines.

Reciprocating Pumps: Classification with constructional details; Theory; Indicator diagram; Net positive suction head; Capacity; Pressure and power calculation; Air vessel and its effects.

Rotary Positive Displacement Pumps: Types, and constructional details.

Centrifugal Pumps: Types, Euler's equation; Theoretical and actual head; Efficiencies; Construction of impeller and casing; Multi-staging; Axial thrust balancing; Specific speed; Characteristic curves; Parallel and series operation; Capacity and Power calculation.

Water Turbines: Classification, Theory, Construction, Operation, Power calculation and governing of Pelton, Kaplan and Francis turbines.

Reciprocating air compressors; Construction; Indicator diagram; Effect of clearance; Efficiencies; Multi-stage air compressors.

Rotary compressors and Fans: Types, Construction, Operation and power calculation.

Selection steps and testing procedure of fluid machines.

#### **References:**

1. Fluid Mech. through problems – R J Garde
2. Hyd. & Fluid Mech. – J. Lal
3. Fluid Mech. – Streeter & Wilie
4. Fluid Mech. – I H Shames
5. Fluid Mech – Som and Biswas
6. Fluid Mech. And Fluid Power Engg. – D.S.Kumar

### **MMC 16104 – FLUID POWER & CONTROL (3—1—0)**

Fluid properties and qualities, Hydraulic and Pneumatic symbols and circuits.

Fluid power fundamentals – Flow through conduits, orifices, minor losses, temperature rise and pressure transients.

Theory, construction and operation of hydraulic pumps, motors, valves, cylinders, power pack and other accessories.

Theory, construction and operation of pneumatic motors, valves, cylinders and other accessories.

Electro-hydraulic servo-valves and servo-mechanism.

Basics of dynamic systems and controls, valve controlled hydraulic system, pump controlled hydraulic system.

Introduction to the use of PLC (programmable Logic control) for sequence control of hydraulic and pneumatic circuits.

#### **References:**

1. Oil Hydraulic Systems, S. R. Majumder, Tata-McGraw Hill Publication
2. Pneumatic System, S. R. Majumder, Tata-McGraw Hill Publication
3. Control system Engineering, Raven, Prentice hall Publication
4. Hydraulic Control Systems, Herbert E. Merritt, John Wiley & Sons
5. Hydraulic Control Systems, Noah D. Manring, John Wiley & Sons

### **MMC 16105 -- I C ENGINES & TURBO MACHINES (3—1--0)**

**I.C. Engines:** Review of basic concepts, Comparison of ideal, fuel-air and real cycles, Use of fuel-air cycle for engine performance prediction.

Fuels for S.I. and C.I. engines, fuel ratings, alternative fuels.

Fuel Injection systems, fuel pump and injectors, MPFI systems.

Principle of carburetion, modifications of carburetors.

Ignition systems, power advancing.

S.I and C.I engines combustion process, detonation and diesel knock.

Cooling and lubrication. Testing and performance. Engine emission and control

Super charging and Turbo charging in Engines.

**Turbo Machines:** Gas Turbines: Classification, Open and Closed Cycle, Regenerative, Reheat, Inter-cooling, Regenerative and reheat cycle and their other combinations.

Jet Propulsion: Theory of Jet Propulsion, types of jet propulsion, thrust, thrust power and propulsive efficiency

#### **References:**

1. The Internal Combustion Engines: C.F. Taylor & E.S. Taylor, Int. Textbook Co.
2. Internal Combustion Engine Fundamentals: J.B. Heywood, McGrawhill Book Co.
3. Fundamentals of Internal Combustion Engines: H.N. Gupta, PHI
4. Internal Combustion Engines: Shyam K. Agarwal, New Age International
5. A Text Book of Internal Combustion Engines: R K. Rajput, Laxmi Publ.
6. Gas Turbine – Ganeshan, V.

### **MMC 16111 – DRILLING ENGINEERING (3—1—0)**

Construction and operation of coal drills, jackhammer drills, drifters, blast-hole drills, DTH drills, jumbo drills; Drill bits and rods; Diamond drilling- principles, operating features, wire line drilling, core barrels, bits, reamer shells, drilling fluid, pumps, fishing tools, standards of components; Oil well drilling- percussive, rotary and bottom drive drilling, bits, drill steel and



components, hoisting and rotary systems, mud circulation systems and accessories, directional drilling, fishing operation, casing design, coring, bore hole problems.

**References:**

1. Drilling-the manual of methods, applications and management; Australian drilling industry training committee Ltd.
2. Diamond drilling; C P Chugh; Oxford & IBH Publishing Co.
3. Manual of drilling technology; C P Chugh; Oxonian Press Pvt Ltd.
4. Drilling technology handbook; C P Chugh.
5. Offshore drilling technology; Frank R Carmichael; Noyes Data Corporation.
6. Applied drilling engineering; SPE Text Book Series.

**MMC 16112 – OPEN CAST PRODUCTION EQUIPMENT (3—1—0)**

Introduction to Surface mining equipment:

Classification of equipment; system with different combination of excavator and transport equipment. Applicability of different surface mining equipment, Mechanics of rock cutting / loading by excavator bucket.

Prime movers used in surface mining equipment:

Turbo-charged diesel engine, construction, operation and maintenance of its subsystems, trouble shooting of the engine.

Classification, construction, operation and maintenance of various sub-systems of shovel, Dragline, Bucket wheel excavator, Scraper, Dumper, Dozer, Pay-Loader, Surface Miner.

Unconventional mining equipment used in surface mining projects.

Recent trends and development of surface mining equipment.

Selection criteria of open cast production equipment .

Safety aspects related to open cast production equipment.

**References:**

1. Recent Development of Heavy earth Moving machineries, A. De, Lovely Prakashan
2. Moving the Earth: Nicholes
3. On and with the Earth: J. Singh

**MMC 16201 -- MECHANICAL ENGINEERING LABORATORY – V (0 -- 0 -- 3)**

Any six will be conducted out of the following experiments.

1. To develop different hydraulic circuits in hydraulic trainer.
2. To study the construction and operation of hydraulic pumps, motors and valves.
3. To study the construction and operation of hydraulic fittings and hoses.
4. Performance investigation of hydrostatic transmission systems with different motors.
5. Performance investigation of close-loop and open-loop hydraulic transmission systems.
6. To study the valve-controlled and pump controlled hydraulic systems.
7. To develop different pneumatic logic circuits in pneumatic trainer.
8. Performance test of centrifugal pumps.
9. Performance test of Pelton turbine.
10. Performance test of Kaplan turbine.
11. Performance test of Francis turbine.
12. Performance test of reciprocating air compressor.

## **MMC 16202 -- MECHANICAL ENGINEERING LABORATORY –VI (0 -- 0 -- 3)**

1. Tool grinding (to provide tool angles) on tool grinder machine tool.
2. Gear cutting on milling, gear hobbing and gear shaping machine tool.
3. Writing a part program for job for drilling/pocketing operation and running on CNC milling machine tool.
4. Writing a part program for job for contouring/thread operation and running on CNC turning machine tool.
5. To conduct a performance test and obtain heat balance on 4-stroke diesel engine.
6. To conduct Morse test on a multi-cylinder petrol engine.

## **SEVENTH SEMESTER**

### **MMC 17101 – MEASUREMENTS & CONTROL (3—0—0)**

Introduction to measurement and measuring instruments, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors.

Sensors, Transducers and Actuators. Signal transmission and processing devices.

Different measurement devices for measuring time, pressure, strain, force and torque, Temperature and Vibration – their principles and performance analysis.

#### **References:**

1. Measurement and Instrumentation in Engineering: Principles and Basic Laboratory Experiments, Francis L. S. Tse, Ivan E. Morse, Marcel Dekker Inc, New York
2. Mechanical Measurement, Beckwith Thomas G, Narosa Publishing House
3. Measurement systems, Application design, E.O. Doeblein, McGraw Hill
4. Mechanical Measurement, Sirohi, New Age publication.
5. Instrumentation, Measurement and Analysis (2/e), Nakra & Chowdhury

### **MMC17102 – MECHANICAL VIBRATION (3—1--0)**

Free and Forced vibration of single degree of freedom system with and without damping concept of phase plane. Response of single degree of freedom system to impulse, periodic and non-periodic excitation. Multi degree of freedom free, forced, undamped and damped vibration; Multi degree of freedom systems- exact analysis and numerical methods; Vibration in continuous systems; Vibration isolation, absorption and measurements in industrial machines

#### **References:**

1. Vibration fundamentals and practices; Clarence W. de Silva; CRC Press.
2. Vibrations and noise for engineers; Kewal Pujara; Dhanpat Rai & Sons.
3. Theory of vibrations with applications; William T Thomson; CBC Publishers & Distributors.
4. Vibrations, waves and acoustics; D Chattopadhyay, P C Rakshit; Books & Allied (P) Ltd.
5. Elements of vibration analysis; Leonard Meirovitch; McGraw-Hill International Editions.
6. Textbook of mechanical vibrations; Rao V Dukkupati, J Srinivas; Prentice Hall of India Pvt. Ltd.

### **MMC 17111 -- BULK SOLIDS HANDLING EQUIPMENT (3--1--0)**

Construction and operation of crushers- jaw, gyratory, cone, roll, hammer, ring granulator, feeder breaker, rotary breaker, in-pit crushers; Construction and operation of feeders, screens, conventional belt conveyors, high angle conveyors, cable belt conveyor, chain conveyors, stackers, reclaimers, wagon loaders, bucket elevators, selection, productivity and power calculations.

**References:**

1. Mechanical conveyors for bulk solids; H Colijn; Elsevier Science Publishers.
2. Materials handling equipment; M P Alexandrov; MIR Publishers.
3. Good year handbook of belting, conveyor and elevator
4. Pneumatic conveying; H. A. Stoess; John Wiley & Sons.
5. Mineral Processing; G Tarjan; Akademiai Kiado.
6. Mineral processing; B. A. Wills; Pergamon Press.

**MMC 17211 -- MINING MACHINERY LABORATORY (0 – 0 – 3)**

Any six will be conducted out of the following experiments.

1. To study the construction of multi-speed gearbox used in dozer.
2. To study the construction and operation of quick drop valve, pump and steering valve.
3. To study the construction of main clutch booster and control valve of Bulldozer machine.
4. To study the construction and operation of turbo-charged diesel engine used in open-pit equipment.
5. Dismantling and assembly of Jack Hammer Drill Machines.
6. Determination of Torsional Rigidity of steel Wires.
7. Determination of Fatigue Strength of Steel Wires.
8. Determination of Breaking Strength of Steel Wire Ropes.
9. Study of LongWall Face layout & Related Equipment
10. Estimation of Discharge Rate in Bunkers with different Hopper Angles.
11. Estimation of Discharge Rate in Electro-magnetic Vibrating feeder for different materials.
12. To find out the angle of friction for different materials.
13. Study of Belt Conveyor, Screw feeder and Mechanical Feeders.
14. Study of SHM of spring-mass systems.
15. Techniques of measuring vibration data from a rotating machines and interpretation.
16. Study of vibration meter, Vibration analyzer and data logger.

**ELECTIVE SUBJECTS****MME 17101 – INDUSTRIAL TRIBOLOGY (3—0—0)**

Introduction: Friction, wear, lubrication and bearings.

Basic equations of the theory of lubrications, its solution for idealized and finite bearings; Calculation of oil flow rate; Methods of application of lubricants; Central lubrication system; Types of lubricants used, their various properties and applications.

Hydrostatic and hydrodynamic bearing.

Theories of friction, asperity adhesion theory of friction and types of friction.

Wear and their measurement procedures; Surface roughness and measurement.

Classification of wear and wear minimization techniques; Monitoring of friction and wear.

**References:**

1. Fundamentals of Tribology – S.K.Basu and Sengupta
2. Engg. Tribology – Prasanta Sahoo
3. Introduction to Tribology of Bearings, B. C. Majumdar

**MME 17102 – MECHATRONICS (3 — 0 — 0)**

**Introduction to Mechatronics:** Definition, Mechatronics in manufacturing, products and design. Comparison between traditional and mechatronic approach. Microprocessor-Based Controllers and Microelectronics. An introduction to Micro and Nanotechnology

**Electronics:** Review of fundamentals of electronics, sensors, micro-sensors, transducers, electrical contacts, actuators, and switches, contact-less input devices, signal processing devices; relays, output devices.

**Drives:** Stepper motors, servo drives.

**Mechanical:** Ball screws, linear motion bearings, transfer systems.

**Hydraulics:** Hydraulic elements, actuators and various other elements. Design of hydraulic circuits.

**Control Systems:** PI, PD and PID controllers, microprocessor, PLC controller and Ladder diagrams, hydraulic and pneumatic controllers; optimal and adaptive control. A/D and D/A Conversion.

Introduction to MEMS, Nano, Micro and Mini-Scale Electromechanical Systems

### **References:**

1. Automatic Control Engineering, F.H. Raven, 5th ed., McGraw-Hill International.
2. Modern Control Engineering, K. Ogata, 3rd ed., Prentice Hall.
3. Mechatronics, Bolton, Pearson Education
4. Automatic Control Systems, B.C. Kuo, 6th ed., Prentice Hall.
5. Mechatronics, HMT Ltd., TMH.
6. Machine design for mobile and industrial applications, G.W. Kurtz, J.K. Schueller, P.W. Claar, SAE.

### **MME 17103 – WASTE HEAT UTILIZATION (3 — 0 — 0)**

Introduction to different sources of waste heat, industrial waste heat.

Methods of utilizing waste heat: Cogeneration, gas turbine, steam turbine, MHD-Steam power.

Different types of energy storage systems, solar energy storage systems.

Second Law of Thermodynamics analysis for refrigeration and heat pump, waste heat refrigeration and air-conditioning systems, heat pump systems.

Utilization of waste heat in organic Rankine cycle engines.

Different types of thermal insulation and its properties.

Waste Heat Recovery Systems: Heat Exchangers, gas to gas, gas to liquid and liquid to liquid heat recovery systems, waste heat boilers, fluidized bed waste heat recovery systems.

Heat Pipes: Working principles, different systems and application.

### **References:**

1. Power Plant Engineering – Nag, P.K.
2. Steam & Gas Turbines and Power Plant Engineering – Yadav, R.
3. A Course in Heat and Mass Transfer –Domkundwar and Arora.
4. Heat and Mass Transfer – R.C.Sachdeva
5. Solar Energy – S.P. Sukhatme
6. Engineering Thermodynamics- P.K. Nag

### **MME 17104 – ADVANCED MANUFACTURING SYSTEMS (3—0—0)**

Group Technology: Concepts, applications, opitz system of classifications, merits and demerits.

Cellular Manufacturing: Principle of cell formations, applications, different methods of cell formations, numerical problems, merits and demerits.

Micro manufacturing.

Lean Manufacturing: concepts, steps, case studies.

Agile Manufacturing: Definitions, tools, method of implementations, relationship between lean and agile manufacturing.

FMS: Concepts of FMS, components, FMS layouts

AGV: Types, navigation system  
CMM: Different types, methodologies, applications.  
CIM: Concepts, applications

**References:**

1. Automation Production System & CIM, M. P. Groover.
2. Materials & processes in Manufacturing, Degarmo, J. T. Black.
3. Lean Manufacturing System & Cell Design, J. T. Black.

**MME 17105 – MECHANICAL SYSTEM DESIGN (3 — 0 — 0)**

Concept of system, system trees and their components, system properties, system feasibility and capability.

System models simulation, design process, design feasibility, design audit and review. System reliability, Quality assurance and maintainability, Optimization in machinery system design, Linear programming, Human factor in systems design, System tolerance and allowance. Design of mechanical system – case studies.

**References:**

1. Mechanical Engineering Design, J. E. Shigley, Mischke & R. Charles.
2. Hand Book of properties of Engineering materials and design data for machine elements, Abdulla Shariff, Dhanpat Rai & Co., 2008.
3. Mechanical System Design, K. U. Siddiqi, 2007
4. Integrated product and process design and development, E. B. Magrab, CRC press, 1997.
5. Engineering Design, George E. Dieter, McGraw Hill, 2001.

**MME 17106 – ENERGY CONVERSION EQUIPMENT (3 — 0 — 0)**

**Energy Conversion Equipment:** Introduction to Different Energy Conversion Equipment.

**Steam nozzle:** Basic concept, Types of nozzles, Flow energy equation in nozzles, Critical Pressure in nozzle flow and choked flow.

**Steam Turbine:** Classification, Impulse turbine, Compounding of impulse turbine, Impulse Blade Sections, Blade heights, Impulse- Reaction Turbine, Height of Impulse-Reaction Turbine Blading, Casing Arrangement, Impulse-Reaction Turbine Blade Sections, Degree of Reaction, Regenerative feed heating, Reheating, Combined regenerative and reheating, Reheat Factor and internal efficiency of the turbines, Condensers and Cooling Towers.

Energy Losses in Turbines

Different Governing Systems of Steam Turbines.

**Nuclear Power Plant:** Principle of Nuclear energy, nuclear fission and fusion, different types of nuclear reactors, PWR, BWR, LMFBR, Safety regulations, Operation and maintenance.

**Magneto Hydrodynamic Power:** Principle of MHD Power generation, Combined MHD-Steam Power Plant.

**References:**

1. Gas Turbine Principles and Practices – Cox, H.R
2. Gas Turbine Theory – Cohen, H.
3. Steam Turbine Theory and Practices – Kearton, W.J.
4. Steam and Gas Turbines- Stodola, A.
5. Power Plant Engineering – Nag, P.K.

## **MME 17107 – AUTOMOBILE ENGINEERING (3 – 0 – 0)**

Introduction: Classification, components and description of an automobile

Chassis and Suspension: Different types of chassis and their construction, Placement of engine at different position on the chassis, Chassis dimensions, Functions and elements of a suspension system, Different types of suspension system, leaf spring, shock absorber, Wheels and tyres.

Transmission: Components of transmission system, Differential – Construction, function and need of differential, Final drive mechanism, Automatic transmission of power.

Steering: Requirements, General arrangement, Steering mechanisms, Component of steering system, power steering, over steering, under steering, wheel alignment.

Braking Systems: Functions, Classification – mechanical. Hydraulic and power brakes, Brake effectiveness, Factors affecting the stopping distance.

Electrical System: Starting system, Charging system, Ignition systems, Lighting and accessory systems.

Auto emission: Emission standard of vehicle in India, Euro norms, emission testing.

Miscellany: Principle and components of multi-point fuel injection (MPFI) systems, Vehicle air conditioning, Fuel economy and safety considerations.

Automotive Stability.

### **References:**

1. A Textbook of Automobile Engineering – R. K. Rajput, Laxmi Publ. (P) Ltd.
2. Automotive Mechanics – W. H. Crouse & D. Anglin, Tata McGraw Hill
3. Automobile Engg. (Vol. 1 & 2) – K. M. Gupta, Umesh Publications

## **MME 17108 -- KNOWLEDGE-BASED SYSTEMS (3 — 0 — 0)**

**Introduction to databases**, Artificial Intelligence, Need for Knowledge based systems in Mechanical Engineering.

**Neural Networks:** feed forward neural network, recurrent neural network, Competitive learning networks, Kohonen self organizing networks, Hebbian learning; Hopfield Networks, Associative Memories.

**Fuzzy Logic:** Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Logic, Classical Logic.

**Genetic algorithms (GAs)** – Binary-coded GA, real coded GA, Messy GA, Visualized Interactive GA

**Other Soft computing approaches:** Simulated Annealing, Tabu Search, Ant colony based optimization, Genetic Programming (GP) etc.

**Hybrid systems** – Combined Soft Computing-based approaches.

### **References:**

1. “Neuro-Fuzzy and Soft computing”, J. S. R. Jang, Sun, Mizutani, Pearson
2. “Neural networks: a comprehensive foundation”, S. Haykin, Pearson
3. “Genetic Algorithms”, D. Goldberg, Pearson
4. “Fuzzy Sets & Fuzzy Logic”, G.J. Klir & B. Yuan, PHI.
5. “Fuzzy logic with engineering application”, Timothy J. Ross
6. “Soft Computing”, D. K. Pratihari, Narosa Publications, 2007

## **MME 17109 -- MACHINE FAULT DIAGNOSIS & CONTROL (3 — 0 — 0)**

Introduction to machine fault diagnosis, condition monitoring; Machine component and system malfunction; parameters and techniques for vibration, noise and lubricant analysis; Data

processing and signal analysis. Instrumentation for recording and analysis; system monitoring and use of models; case studies with specific machine faults; Future developments.

**References:**

1. Fault Diagnosis: Models, Artificial Intelligence, Applications, Józef Korbicz , 2004
2. Robust model-based fault diagnosis for dynamic systems, J. Chen and R. J. Patton, Kluwer Academic Publishers, Boston, 1999.
3. Åström, K., Albertos, P., Blanke, M., Isidori, A. et.al. (Eds), Control of complex systems, Springer-Verlag, London Limited, 2001.
4. Blanke M., Kinnaert M., Lunze J. and Staroswiecki M. (eds.), Diagnosis and Fault-Tolerant Control, Springer-Verlag, 2003.
5. Gertler, J., Fault Detection and Diagnosis in Engineering Systems, New York: Marcel Dekker, 1998.
6. Machinery Analysis and monitoring, John S. Mitchell.

**MSR 17153 -- OPERATIONS RESEARCH (3--0--0)**

Decision-making process, classification of decision-making situations, pay-off matrix, Opportunity cost matrix, Decision making under risk and uncertainty.

Operation research technique and mathematical modeling --- concept and applications in engineering and management problem solving; Principles of optimization, feasible and optimal solution.

Linear programming – model formulation and application; Graphical method of solution; Simplex algorithm; Concept of sensitivity analysis;

Transportation problem – formulation and solution; Introduction to assignment problems.

Queuing / Waiting line model – Characteristics and parameters; Application of queuing analysis in decision making.

Introduction to replacement analysis.

**References:**

1. Operations Research, Hamdy A Taha
2. Operations Research, F. S. Hillier and G. J. Liberman
3. Operations Research, A M Natarajan, P Balasubramani, and A Tamilarasi
4. Operations Research, S Kalavathy

**EIGHTH SEMESTER**

**MMC 18101 – MECHANICAL HANDLING EQUIPMENT (3—1—0)**

Mechanical handling equipment for handling unit load and bulk materials – classification, application and selection.

Material handling systems – parameters affecting design and operation.

Design and construction of various components of mechanical handling devices like wire ropes, chains, drums, sheaves, sprockets, hooks, shackles, grabs, ladles, arresting gears, brakes, gears and power transmission, couplings, motive power units – diesel and electric.

Winches, pulley blocks, capstan, lifting electromagnets, grab buckets and conveyors.

Mobile jib cranes – different types, EOT cranes, pillar cranes, lower cranes, gantry cranes, radial cranes.

Hoist, travel and slew mechanisms of mechanical handling equipment. Stability of mobile cranes.

Programmable and flexible load handling devices, automation in the handling of materials.

### **References:**

1. Material Handling equipment, N. Rudenko, Peace Publishers.
2. Conveyors and Related Equipment, Spivakowsky and V. Dyachkov, Peace Publishers.
3. Material Handling, R. John Immer, McGraw Hill & Co.
4. Material Handling equipment, D. O. Haynes, Chilton & Co.
5. Handbook of Material Handling, H. Bolz.

### **MMC 18111 – MINERAL TRANSPORT AND LOADING EQUIPMENT (3—1—0)**

Construction, operation, selection and productivity calculation of mine winders, locomotives, rope haulages; Construction, operation and selection of LHDs, SDLs, LPDTs, Shuttle cars; Hydraulic and pneumatic conveying; Special requirements of conveyors for use in underground mines.

### **References:**

1. Elements of mining technology; R T Desmukh.
2. Mechanics of bulk materials handling; Norman Brook; London Butterworths.
3. Mining mechanical engineering; R Khadzhikov, S Butakov; MIR Publishers.
4. ASME Publications from 1995 Onwards.

### **MMC18112 -- UNDERGROUND PRODUCTION EQUIPMENT (3—1—0)**

Classification of machinery for production by drilling-blasting method and mechanical cutting in underground coal, metal and other mines.

Coal cutting machine – Classification and construction.

Shearers: Evaluation steps, single & double drums, left & right hand drums, fixed & ranging drums, mechanical & hydraulic haulage, chain & chainless haulage, all electric shearer, cable handling, trapping methods, water spraying system, pick & pick boxes, shearer bridge, speed control, power calculation and selection, AFC, stage loader, construction & power calculation.

Ploughs: Types, construction and operation, limitation of ploughing, mechanics of ploughing, methods of speed and horizon control, comparison with shearer, power assessment and selection.

Hydraulic Mining: Hydraulic breaking and transportation, type of jets and water pressure, factors affecting hydraulic breaking.

Heading Machines: Classification, cutting, loading, propel mechanisms and drive arrangement of road header, dirt header and continuous miners.

Supports: Construction and setting of steel arches, goal post supports, friction props, hydraulic props – closed and open circuit, link bars, roof bolting & stitching, powered supports – frame, chock, shield & chock – shield types, power packs.

Safety and regulations related to underground production machinery.

### **References:**

1. Longwall Mining, Syd S. peng & H. S. Chiang
2. Mining technology Vol. I & II, R. T. Deshmukh.



## ELECTIVE SUBJECTS:

### MME 18101 -- FINITE ELEMENT ANALYSIS (3 — 0 — 0)

Principles of variation calculus.

**Methods of Finite element analysis:** stiffness method, potential energy and Rayleigh-Ritz method, Galerkin FE formulation, element formulation, and coordinate transformation, isoparametric formulation.

**Applications:** problems of structural mechanics and solid mechanics. Plane stress & plane stress problems, 3-D problems. Torsion, bending of plates and shells. FE formulations for vibrations, heat transfer and fluid flow problems.

Associated flowcharts and computer programming.

#### **References:**

1. Introduction to Finite Elements in Engineering, T. R. Chandrupatla & A. D. Belegundu, 2<sup>nd</sup> Ed., PHI, 2001.
2. An Introduction to the Finite Element Method, Reddy, J. N., 2005.
3. The Finite Element Method, O. C. Zienkiewicz, 3<sup>rd</sup> Ed., McGraw-Hill, 1997.
4. The Finite Element Method in Engineering, S. S. Rao, 2nd Ed., Elmsford, Pergamon, 1989.
5. Introduction to the Finite Element Method: A Numerical Method for Engineering Analysis, Desai, C. S. and Abel, J. F., 1972

### MME 18102 -- MAINTENANCE ENGINEERING (3 — 0 — 0)

Maintenance – Key to reliability & productivity. Basic elements of maintenance system – inspection, planning & scheduling, job execution, record keeping, data analysis, learning & improvement.

Basic definitions, preventive, operating and shutdown maintenance; Condition based maintenance and condition monitoring. Application of preventive maintenance for system of equipment.

Vibration and signature analysis; causes; remedy in rotating machinery. Fluid analysis for condition monitoring, various methods of fluid analysis.

Non-destructive testing, principle methods such as dye-penetrant, magnetic particle testing and ultrasonic tests.

Lubrication: Introduction to lubrication engineering, types, classification of lubricants with their properties and characteristics. Bearing lubrication technique for minimization of friction and wear.

Science of friction and wear; Different types of wear, such as abrasive, corrosive, seizure, scoring, scuffing, pitting, spalling, adhesive, etc. and techniques for minimization of wear.

Data collection and analysis, Introduction to computer-aided maintenance management system.

#### **References:**

1. Industrial Maintenance – H.P.Garg
2. Ind. Maint. Management – S.K.Srivastava

### MME 18103 -- COMPOSITE MATERIALS (3 — 0 — 0)

**Introduction to composites:** Classification, strength and stiffness advantages, manufacturing aspects of composites.

**Macro-mechanical** behavior of a Lamina, stress-strain relations and engineering constants of anisotropic and orthotropic materials, restriction of elastic constants, stress-strain relations for a lamina of arbitrary orientation, biaxial strength theories of orthotropic lamina.

**Micro-mechanical behavior:** mechanics of materials approach to stiffness, elasticity approach to stiffness, bounding techniques, Halpin-Tsai equations, mechanics of materials approach to tensile and compressive strengths.

**Macro-mechanical behavior of a Laminate:** classical lamination theory, laminate stiffness for symmetric, anti-symmetric and non-symmetric laminates and strength of laminates of various configurations, inter-laminar stresses, design of laminates.

**References:**

1. Mechanics of Composite Materials, R. M. Jones, 2<sup>nd</sup> Ed., Taylor & Francis, Philadelphia, 1999.
2. Engineering Mechanics of Composite Materials, I. M. Daniel & O. Ishai, 2<sup>nd</sup> Ed., Oxford University Press, 2006.

**MME 18104 -- AUTOMATION AND ROBOTICS (3 — 0 — 0)**

**Automation:** basic concepts, automatic handling of parts using relays, positioned limit switches, Line transfer, Rotary transfer of Geneva mechanism, Electro-hydraulic or pneumatic systems.

**Robot definition,** robot anatomy; robot classifications and specifications.

**Robot kinematics:** forward and reverse transformation, homogeneous transformations.

**Robot actuators and control:** Pneumatic, hydraulic, electrical drives and controls

**Robot end-effectors:** mechanical, magnetic and vacuum grippers, gripping forces and design features of grippers.

**Robot sensors:** different types of contact and non-contact sensors; Robot vision and their interfaces;

**Robot languages and programming techniques**

**Applications of Robots:** Robots in materials handling, machine loading/unloading, inspection, welding, spray-painting and finish coating, and assembly, etc.

**Economic performance and evaluation strategies,**

**Robot installation and planning.**

**Safety features.**

**References:**

1. Industrial Robotic Technology - Programming and Application by M.P. Groover et. al., McGraw-Hill
2. Robotics for Engineers by Y. Koren, McGraw-Hill.
3. Robotics Technology and Flexible Automation by S.R. Deb, TMH.
4. Robotics: Control, Sensing, Vision and Intelligence, K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw-Hill International Editions, 1987.
5. Introduction to Robotics, J. J. Kraig.
6. Robotic Engineering, Klafta et al.

**MME 18105 -- POWER PLANT ENGINEERING (3 – 0 – 0)**

Thermal Power Plants: General layout of modern power plant, Site selection, Fuels and fuel handling, Combustion – mechanism, equipment and firing methods, Steam generators – types, economizer, superheater, reheater and air preheater, Fluidized bed boilers, Ash handling systems, Dust controlling methods, Condensers, Cooling towers, Feed water treatment.

Gas Turbine Power Plant: Selection of plant, Components, Layout and site selection of plant, Advantages and disadvantages.

Diesel Engine Power Plants: Applications of diesel engine plants, General layout, Advantages and disadvantages,

Nuclear Power Plants: Selection and location of nuclear power plant, Fusion and Fission principle, Types of reactors, nuclear materials and waste disposal, Effect of nuclear radiation and safety aspects.

Hydraulic Power Plants: Location of plant, Classification, Essential elements and layout of the plant, Selection of turbine, Economics of power generation, Advantages and disadvantages.

Combined Cycle Power Generation: Binary Vapour cycles, Coupled cycles, Combined cycles, Gas turbine – steam, MHD – steam and thermionic – steam power plants.

**References:**

1. Power Plant Engineering – Nag, P.K.
2. Steam & Gas Turbines and Power Plant Engineering – Yadav, R.
3. Steam Turbine Theory and Practices – Kearton, W.J.
4. Steam and Gas Turbines, Stodola, A.

**MME 18106 – SYSTEM MODELING & SIMULATION (3--0--0)**

Introduction, Power variables, constitutive laws, physical system coordinates.

The notion of causality, generation of system equations,

Dynamics of rigid bodies, modeling in non-inertial coordinates, modeling of Physical systems: Electrical systems, mechanical systems, structural members, thermal systems, and hydraulic systems.

Art of creating system bond graph, application of bond graphs to control systems, signal flow graph.

Simulation with software: SYMBOLS and MATLAB-SIMULINK

**References:**

1. Karnopp, D. C. Rosenberg, R.C. and Margolis, D.L. "System Dynamics: A Unified Approach" John-Wiley and Sons Inc., 1990.
2. Mukherjee, A., Karmakar, R. and Samantaray, A.K. Bond Graph in Modeling, Simulation and Fault Identification. I. K. International: New Delhi, India, ISBN 81-88237-96-5, 2006

**MME 18107 – NOISE ENGINEERING (3 — 0 — 0)**

Fundamentals of noise and noise acoustics; Physical properties of noise; Noise techniques, measurement and instrumentation; Randomness in noise; Human response and ratings; Noise in industrial machines; Estimation and control of noise; Noise standards and legislation; Noise propagation and attenuation; Acoustic materials for noise control.

**References:**

1. Industrial noise and control-fundamentals and applications; Lewis H Bell, Douglas H Bell; Marcel Dekker Inc.
2. Vibrations and noise for engineers; K. K. Pujara; Dhanpat Rai & Sons.
3. Noise pollution and control, S. P. Singal, Narosa Publishing House.

**MME 18108 – FRACTURE MECHANICS (3—0—0)**

Stress – analysis of cracked bodies, LEFM and EPFM approaches, stress intensity factor, strain energy release rate criteria.

Fracture toughness. Experimental determination of stress intensity factor and fracture toughness for engineering materials, J-integral, COD, CTOD concepts of fracture.

Crack propagation and sub-critical crack growth: assessment / prediction of structural life inspection technique for locating service-cracks.

Effect of temperature on fracture.

**References:**

1. Elementary Engineering Fracture Mechanics, D. Broek, 4<sup>th</sup> Ed., Martinus Nijhoff, 1985.
2. Fracture Mechanics Fundamentals & Applications, T. L. Anderson, 2<sup>nd</sup> Ed., CRC, 1995.
3. Fundamental of Fracture Mechanics, J. F. Knott, 2<sup>nd</sup> Ed., Wiley, 1979.
4. Fracture and Fatigue Control in Structures, J. M. Barsoum & S. T. Rolfe, 3<sup>rd</sup> Ed., ASTM, 1999.

**Capsule Courses offered by the Dept. of ME & MME****SIXTH SEMESTER****MMR 16101 – Mining Machinery I (3 — 0 — 0)**

Classification, application, constructional features of drilling machines used in coal and metal mining, coal cutters, shearer, plough, continuous miner, road header and dint header, loading and transport equipment, man riding systems.

Classification and constructional difference of different types of winders, mechanics of winding, power calculation, rope selection, inspection and maintenance. Safety features and automatic contrivances.

Classification, construction and selection steps for mine dewatering pumps.

**SEVENTH SEMESTER****MMR 17101 – Mining Machinery II (3 — 0 — 0)**

Construction and operation of blast hole drills, rippers, shovels, hydraulic excavators, scraper, dragline, dumpers, wheel loaders, dozers, graders. Surface miners, BWE, spreader, stacker & reclaimer.

High capacity belt conveyors – constructional detail and selection procedures.

Aerial rope ways – classification, layout and constructional features.

Classification, application and constructional features of crushers, breakers and feeders.