COURSE STRUCTURE & SYLLABUS

OF

M. TECH IN MINE ELECTRICAL ENGINEERING

(EFFECTIVE FROM 2015-16 ACADEMIC SESSION)

COURSE STRUCTURE FOR
M. TECH IN MINE ELECTRICAL ENGINEERING
(EFFECTIVE FROM 2015-16)

FIRST SEMESTER

S No.	Course No.	Name of the Course	L	T	P	CH
		THEORY				
1.	AMC 51151	Advanced Numerical Methods and Applied Statistics	3	1	0	7
2.	MMC 51110	Mining Machinery	3	1	0	7
3.	MMC 51111	Mine Electrical Technology	3	0	0	6
4.	MER 51110	Mining Practices and Unit Operations	3	0	0	6
5.		**Elective (any one)**	3	0	0	6
	MME 51110	Special Electro-mechanical Devices				
	MME 51111	Power System Analysis				
	MME 51112	Modelling and Analysis of Electrical Machines				
	MME 51113	A. C. Controller				
		PRACTICAL & OTHERS				
7.	MMC 51211	Mine Electrical Technology Lab	0	0	3	3
8.	MMC 51410	Seminar	0	0	2	2
9.	MMC 51610	Industrial Visit	0	0	0	(2)
		Industrial Training (For two weeks, to be credited in 2nd semester)				
		Total Credit Hours	-	-	-	37+(2)
		Total Contact Hours=22	**15**	**2**	**5**	-

SECOND SEMESTER

S No.	Course No.	Name of the Course	L	T	P	CH
		THEORY				
1.	MMC 52110	Mine Electrical Drives	3	1	0	7
2.	MMC 52111	Mine Sub-station Design	3	0	0	6
3.	MMC 52112	Mine Electrical Safety	3	0	0	6
4. & 5.		**Elective (any two)**	2[3–0–0]			12
	MME 52110	Advanced Electric Drives				
	MME 52111	Microprocessor Based System Design				
	MME 52112	Power System Protection				
	MME 52113	Mine Instrumentation				
	MME 52114	Power System Transients				
		PRACTICAL & OTHERS				
6.	MMC 52210	Electrical Drives Lab	0	0	3	3
7.	MMC 52410	Seminar	0	0	2	2
8.	MMC 52004	Industrial Training (Training taken after 1st Semester)	0	0	0	(2)
9.	MMC 52610	Industrial Visit	0	0	0	(2)
10.	MMC 52504	Comprehensive Viva-Voce				(2)
		Industrial Training (Two weeks, to be credited in 3rd semester)				
		Total Credit Hours	-	-	-	34.5+(6)
		Total Contact Hours=21	15	1	5	-

THIRD SEMESTER

Course No.	Name of the Course	L – T – P	Credit Hours
MMC 53902	Industrial Training (taken after 2ndsemester)	0–0–0	(4)
MMC 53402	Seminar and Viva Voce on industrial training	0–0–0	(2)
MMC 53802	Interim Dissertation	0–0–0	(14)
MMC 53403	Seminar and Viva Voce on Dissertation	0–0–0	(10)
MMC 53002	Teaching Assignment Evaluation / Laboratory Development Work etc.	0–0–0	(10)
	Total	0–0–0	(40)

FOURTH SEMESTER

Course No.	Name of the Course	L – T – P	Credit Hours
MMC 54802	Dissertation	0–0–0	(15)
MMC 54402	Seminar on Dissertation	0–0–0	(5)
MMC 54502	Viva Voce on Dissertation	0–0–0	(10)
MMC 54002	Teaching Assignment Evaluation/ Laboratory Development Work etc.	0–0–0	(10)
	Total	0–0–0	(40)

FIRST SEMESTER

THEORY

AMC 51151 3-1-0
ADVANCED NUMERICAL METHODS AND APPLIED STATISTICS

Part-1 (Advanced Numerical Methods)

Solution of tri diagonal systems. Evolution of double and triple integrals by numerical method and its application, solution of non-linear simultaneous equations, numerical solution of integral equations and higher order O. D. E., initial and boundary value problems, numerical solution of partial differential equations, Laplace and Poisson equation, heat conduction and waved equation.

Part-2 (Applied Statistics)

Review of binomial, Poisson, normal and log normal probability distributions, interval estimates, tests of significance for mean, variance (one and two-population case, Z, t, χ^2 and F test), tests or correlation and regression coefficients, non-parametric tests-Sign test, Mann Whitney Wilcoxon U-test, run test and test of randomness, one way and two-way analysis of variance, time series analysis, reliability and life testing experiments in engineering problems.

References :

1. Numerical Methods for Scientific, M K Jain, SRK Iyengar and R K Jain
2. Numerical Methods, E. Balaguruswamy
3. Numerical Methods, S Dey and S. Gupta
4. Numerical Methods, E. V. Krishnamurthy and S K Sen
5. Fundamentals of Mathematical Statistics, S. C. Gupta and V K Kapoor
6. Fundamentals of Applied Statistics, S. C. Gupta and V K Kapoor
7. Miller & Friends's Probability and Statistics for Engineers, Richard A. Johnson
8. Probability and Statistics in Engineering, W W Hines, DC Montgomary

MMC 51110 3-1-0
MINING MACHINERY

Underground ore transporting equipment – rope haulage, belt conveyor, locomotive

Mine winders, LHD, SDL, LPDT, continuous miners

Underground mine drills – coal drills, jack hammers, drifters, jumbo drills, shearers; Road headers; Dint headers; Roof bolting machines.

Open pit ore transporting equipment – dumpers, high angle belt conveyor, pipe conveyor, aerial ropeway.

Excavators – Shovels; draglines, Bucket wheel excavators; Dozers; Drills – Blast hole drills, DTH; Crushers.

MMC 51111 3-0-0
MINE ELECTRICAL TECHNOLOGY

Transmission and Distribution of Electrical Power in Mines: Performance of short transmission lines; radial and ring main distribution systems, substation arrangements for open pit and underground mines, distribution of electrical power in mines, Surface mine sub-station capacity selection.

Mining type switchgears and protective devices: Types of circuit breakers, Gate end box, Drill Panel, Transwitch and Field Switch, Remote control and interlock circuits for mining type circuit breakers, Solid-state protective devices for modern mining type circuit breakers.

Symmetrical faults and circuit breaker rating calculation.

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

Electrical Power Planning for mechanized longwall coal face, general electrical distribution scheme, voltage drop problems and remedial measures, Inbye substation capacity selection.

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

Electrical drives and Power Semiconductor Controller: Selection of motors and motor power rating calculations for mining applications; Selection of starters for Mine Electrical Drives, Power semiconductor devices, Solid state variable speed A.C and D.C motor drives for mining applications.

Electric Braking: Types of electric braking, Braking of d.c motor, induction motor and synchronous motor, Energy relation during braking, Dynamics of braking.

References :

1. Electrical equipment in Mines, H. Cotton
2. Coal Mining Practice, I.C.F. Statham
3. Mine winders and Winding Systems, P. K. Chakrabarty

MER 51110 3-0-0
MINING PRACTCES AND UNIT OPERATIONS

Surface Mining

Introduction; Mine Development; Unit operations; Mine systems and mine equipment; Methods of working for sub-surface and hilly deposits; Waste dump formation.

Underground Coal Mining

Introduction; Classification and selection of mining methods; Bord & Pillar development layouts and extraction methods; Longwall mining; Stowing in

underground coalmines; Mine Ventilation.

Underground Metal Mining

Introduction; Classification and selection of underground metal mining methods; Development layouts and extraction for open stope; Cut and fill; Shrinkage stoping and sub-level caving.

References:

1. Introductory Mining Engineering, Howard L Hartman, Jan M Mutmansky, Pushp Print Services.
2. Mining Science and Technology, Guo & Golosinski, Balkerdma, Rotterdam.

MME 51110 3-0-0
SPECIAL ELECTRO-MECHANICAL DEVICES

Linear induction motors and actuators. Permanent magnet motors. Disc motors. Stepper motors: brushless motors. High performance energy efficient machines. Special induction generators and control. Servo motors, special duty motors, Switched Reluctance Motor, Special electrical machines associated with non-conventional energy sources.

References:

1. Special Electrical Machines, K. V. Ratnam
2. Special Electrical Machines, E.G. Janardanan

MME 51111 3-0-0
POWER SYSTEM ANALYSIS

Algorithms for formation of bus admittance and impedance matrices. Power flow solutions: Gauss seidel, Newton Raphson, Fast decoupled power flow. Short circuit studies. Sparsity exploitation in power system studies. Static equivalents for power systems. Concepts of security states and security analysis in power systems. State estimation in power systems, Voltage stability analysis.

References:

1. Power System Analysis and Design by J. Duncan Glover , Mulukutla Sarma ,Thomas Overbye
2. Power System Analysis by Grainger
3. Power System Analysis by G.Shrinivasan
4. Power System Analysis by N. V. Ramana

MME 51112 3-0-0

MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

Energy state functions. Modelling of electromechanical systems. Matrix methods and use of generalized circuit theory of machines. Different methods of transformation d.c phase variable, instantaneous symmetrical component techniques. Reference frames. Development of basic performance equation and analysis of different rotating machines such as d.c, synchronous and induction machines. Dynamics and transients in electric machines. Switching transients and surges. Transient and short circuit studies on alternators, Run-up reswitching and other transient in induction machines. Relevant computer techniques for machine analysis. Modelling of special electrical machines.

References:

1. Advanced Electrical Drives: Analysis, Modeling, Control by Rik De Doncker ,Duco W. J. Pulle, André Veltman
2. Matrix Analysis of Electrical Machines by A. K. Mukhopadhyay
3. Analysis of Electric Machinery and Drive Systems by Paul C. Krause ,Oleg Wasynczuk, Scott D. Sudhoff

MME 51113 3-0-0
A. C. CONTROLLER

Single phase and three-phase buck controllers. Triggering techniques for power factor and harmonic controls. Design and analysis of phase control circuits. Solid state transfer switches.

Concepts of three-phase to single phase and single phase to three-phase cyclo-converter. Symmetrical and asymmetrical control. Harmonic analysis of the output voltage. Effect of source inductance.

Single phase and three-phase inverter, configuration of VSI & CSI. Concept of PWM techniques – single and multiple pulse form, Reduction of harmonics. Software and hardware methods of generating firing pulses. Basics of Multilevel Inverter, Matrix Converter.

References:

1. Power Electronics Handbook, M. H. Rashid
2. Modern Power Electronics & AC Drives, B. K. Bose
3. Vector Control and Dynamics of AC Drives by D. W. Novotny ,T. A. Lipo
4. Thyristor Control of AC Circuits by W. Shepherd.

PRACTICAL & OTHERS

MMC 51211 0-0-3
MINE ELECTRICAL TECHNOLOGY LAB

Experiments on Gate End Box, Drill Panel, CBT Based Earth fault relay, Over load relay, Intrinsically safe circuit, Flame Proof Enclosure

SECOND SEMESTER

MMC 52110 **3-1-0**
MINE ELECTRICAL DRIVES

Dynamics of Electrical Drives: Types of loads, Quadrantile diagram of speed-torque characteristics, Dynamics of motor-load combination.

Starting and braking characteristics of AC and DC motor.

Selection of Motor Power Rating – Thermal model of motor for heating and cooling, Classes of motor duty, Determination of motor rating.

Mine Winder – AC and DC drives for winders, Ward-Leonard drive for DC winder, Solid state variable speed DC winder, AC winder with liquid controller, Electrical braking for AC and DC winders, Electrical control circuit and safety devices for mine winder.

Electric Rope Shovel – Shovel electrical system, Operation of electric rope shovel, Electrical drives arrangement, speed control method of AC and DC Shovel drives, Electrical braking system, Power control systems, Switched Reluctance drive for electric rope shovel, Protection of shovel electrical systems.

Dragline – Basic electrical scheme, Operation of dragline electrical system, Electrical drives and speed control method, Power control system, Electrical braking system, Protection of dragline Electrical systems.

Drill and Dumper – Electrical drives arrangement and operation, Variable speed AC and DC drives, Method of speed control, Protection of drives.

Solid-state variable speed drives for mine ventilation fan, pump and haulage.

References:

1. Mine winders and Drive System, P. K. Chakrabarti
2. SME Mining Engineering Handbook, 3rd edition
3. Mine winding and transportation, M. A. Ramulu

MMC 52111 **3-0-0**
MINE SUB-STATION DESIGN

Principle of Sub-station design, Types of Sub-station, Bus bar systems and layout, Design of Bus bars, Insulators, Sub-station equipment, Insulation Co-ordination and surge Arresters, Design of Sub-station grounding system, Power Cables, Auxiliary supplies and battery systems, Protection, Control and automation in Sub-station, Power line carrier Communication and Tele-control of Sub-stations, SF_6 Gas insulated Sub-station (GIS) and Gas insulated cables, Reactive power management, Testing and maintenance of Sub-station equipment.

References:

1. Substation Structure Design Guide by Leon Kempner Jr.
2. Electric Power Substations Engineering by John D. McDonald
3. Electrical Transmission and Substation Structures by Marlon W. Vogt

MMC 52112 **3-0-0**
MINE ELECTRICAL SAFETY

Neutral Grounding practices for safe operation of underground coal face and open pit equipment - Concept of earth fault current limitation in underground (UG) and open pit mine power systems, Type of electrical power supply systems for UG and Open Pit mines, Solidly earthed, restricted-neutral and insulated-neutral systems of power supply - their comparison.

Earth fault protection techniques for various types of mine power supply systems.

Safety aspects of pilot circuit operated underground coal face machines.

Protection of underground and surface mine power distribution network, Mine electrical drive protection.

Online Condition Monitoring of mine electrical drive.

Online Insulation Monitoring of cable for insulated neutral system of power supply.

Mine Winder safety devices – Winder depth and speed indicator, Automatic Contrivances – over speed, over wind, slack rope and rope slip detection systems.

Mechanized Longwall Coal face Signaling and Communication System, Haulage and Shaft Signaling systems.

Mine Lighting – Illumination planning for underground and open pit mines, Intrinsically safe coalface lighting system.

Mining Cable: Types, construction and selection of cables, Cable size determination for various applications and installations.

Earthing practice for underground and open pit equipment.

Electrical equipment in explosive atmosphere - Method of protection for safe operation of electrical equipment, construction, testing and maintenance of FLP enclosure.

Principle of Intrinsically safe circuit design, Testing of intrinsically safe circuit, Intrinsically safe: mining apparatus, Signaling circuit, Underground mine communication system, Data transmission system, Monitoring devices and transducers.

Safety requirement for mines as per CEA regulations.

References:

1. SME Mining Engineering Handbook, 3rd edition
2. CEA Regulations, Ministry of Power, Govt of India.
3. DGMS Annual Report, 20

ELECTIVE SUBJECTS (ANY TWO)

MME 52110 3-0-0
ADVANCED ELECTRIC DRIVES

Closed loop control of solid state DC drive, Scalar and vector control of induction motor, Direct torque and flux control on induction motor, Self-controlled synchronous motor drive, Vector control of synchronous motor, Switched reluctance motor drive, Brushless DC motor drive, Permanent magnet drives, Modern Industrial drives.

References:

1. Advanced Electrical Drives: Analysis, Modeling, Control by Rik De Doncker , Duco W. J. Pulle, André Veltman
2. Electric Drives by N. K. De ,P. K. SEN
3. Fundamentals of Electrical Drives by G. K. Dubey

MME 52111 3-0-0
MICROPROCESSOR BASED SYSTEM DESIGN

Microcomputer System: An overview, Varieties of microprocessor architecture. Architecture of 16-bit microprocessor and support chips: signals, timing, programming models, instruction sets, addressing modes, assembly language, system software, Programmed I/O and interrupt structure, synchronous and asynchronous interface, standard bus structures, hardware/software trade-offs. Micro programmable microprocessor, microcontroller and transputers: 80286/287, 80386, 68010, 68020. Case studies and application example.

References:

1. Design of Microprocessor based system, N. A. Alexandridls
2. Microprocessor and Microcomputer based system Design, M. Rafiquzzaman

MME 52112 3-0-0
POWER SYSTEM PROTECTION

Basic Principles – CTs, PTs. Static relay. Modern circuit breakers Protection of power transformers, alternators, transmission lines, cables, reactors and capacitors. Protection of motors, rectifiers and thyristors. HVDC protection. Relay coordination, Numerical relaying algorithms, Travelling wave relays, adaptive relaying.

References:

1. Electrical Power System Protection by A. Wright, C. Christopoulos
2. Practical Power System Protection by L. G. Hewitson ,Mark Brown ,Ramesh Balakrishnan
3. Power System Protection & Switchgear by Oza

MME 52113 3-0-0
MINE INSTRUMENTATION

Mine Environment Monitoring: Monitoring of methane, carbon monoxide, oxygen, carbon dioxide, temperature, humidity, air velocity. Different methods of continuous monitoring, data transmission and Tracking. Underground Voice communication, Leaky feeder and Fiber optic based systems. Applicability of Wireless communication systems. Digital Telephony and RFID based communication. TTE Messaging. Underground mine roof subsidence monitoring

GPS based Positional and Dispatch Management System in surface mine. Surface Slope Stability Monitoring. Anti-collision devices. Condition monitoring instrumentation systems for HEMM

Programmable Logic Controller (PLC): operating principle, concept of ladder logic, use of Timer, Counter. Application of PLC in underground mine, open-pit mine and mine beneficiation plant.

References :

1. The Gas Monitoring Handbook, G. L. Anderson, D. M. Hadden
2. SME Mining Engineering Handbook, 3rd Edition
3. Programmable Logic Controllers, W. Bolton

MME 52114 3-0-0
POWER SYSTEM TRANSIENTS

Origin and nature of transients and surges. Surge parameters of plant. Equivalent circuit representations. Lumped and distributed circuit transients.

Line energisation and de-energisation transients. Earth and earthwire effects. Current chopping in circuit breakers. Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short line fault studies. Control of transients.

Lightning phenomena, Influence of tower footing resistance and earth resistance. Travelling waves in distributed parameter multiconductor lines, parameters as a function of frequency.

Simulation of surge diverters in transient analysis. Influence of pole-opening and pole reclosing. Fourier integral and Z- transform methods in power system transients.

Insulation Co-ordination: Overvoltage limiting devices, dielectric properties, breakdown of gaseous

insulation, braking and erosion of insulation, high current arcs, metallic contacts.

References:

1. Power System Transients: Theory and Applications, Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno
2. Power System Transients: A Statistical Approach, C.S. Indulkar, D.P. Kothari, K. Ramalingam

PRACTICAL

MMC 52210 **0-0-3**
ELECTRICAL DRIVES LAB

Experiments on Solid state variable speed A.C. and D.C. motors, Electrical Braking of A.C. and D.C. motors, PLC, Soft starting