JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech ME for MINING ENGINEERING PROGRAMME

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

I-Semester

S.No	Code	Course Name		L	T	P	C
1	MN 101	Advanced Rock Mechanics and Ground Control		3	0	--	3
2	MN 102	Mine Planning and Design		3	0	--	3
3	Program Elective – I MN 103	MN1031	Ground Improvement Techniques	3	0	--	3
		MN1032	Tunneling and Underground Space Technology				
		MN1033	Modern Surveying Techniques				
4	Program Elective – II MN 104	MN1041	Instrumentation In Mining	3	0	--	3
		MN1042	Introduction to Robotics and Application to Mining				
		MN1043	Remote Sensing & Geographical Information Systems				
5	MN 105	Rock Mechanics Lab		-	--	4	2
6	MN 106	Mine Planning and Design Lab		-	--	4	2
7	MN 107	Research Methodology and IPR		2	0	0	2
8	MN 108	Writing Skills for Scientific communication		2	0	0	0
			Total				18

II-Semester

S.No.	Code	Course Name		L	T	P	C
1	MN 201	Mine Safety Management		3	0	--	3
2	MN 202	Mine Ventilation and Planning		3	0	--	3
3	Program Elective – III MN 203	MN 2031	Surface Mine Environmental Engineering	3	0	--	3
		MN 2032	Mine System Engineering				
		MN 2033	Sustainable Mining Industry				
4	Program Elective – IV MN 204	MN 2041	Geo- Statistics	3	0	--	3
		MN 2042	Advance Underground Mine Planning and Design				
		MN 2043	Numerical Methods in Geotechnical Engineering				
5	MN 205	Geotechnical Engineering Lab		--	--	4	2
6	MN 206	Mine Ventilation and Planning Lab		--	--	4	2
7	MN 207	Mini Project with Seminar		0	0	4	2
8	MN 208	Value Education		2	0	0	0
			Total				18

III-Semester

S.No	Code	Course Name		L	T	P	C
1	MN 301	Program Elective /MOOCS		3	0	--	3
		MN 3011	Introduction to Petroleum Engineering				
		MN 3012	Computational Fluid Dynamics				
		MN 3013	Finite Element Analysis				
2	MN 302	Open Elective / MOOCS		3	0	--	3
3	MN 303	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)*		--	--	20	10
			Total				16

* Evaluated and displayed in 4th Semester marks list
** Students Going for Industrial Project / Thesis will complete these courses through MOOCS

IV-Semester

S No.	Code	Course Name	L	T	P	C
1	MN 401	Dissertation Phase II (Continued from III Semester)	0	0	32	16
		Total				16

M.Tech - I Sem		L	T	P	C
		3	0	0	3
ADVANCED ROCK MECHANICS AND GROUND CONTROL					

UNIT I - Stress Analysis: Stress analysis in 2D and 3D, equations of equilibrium, Mohr's Circles, plane stress and plane strain condition, stress distribution in simple structures, Flexure of beams and rectangular plates

UNIT – II- Properties of Rocks: Physico-mechanical properties of rocks including tri-axial strengths and in-situ strengths and their application in the design of different types of excavations, rock indices viz. drillability index, caving index, etc. Time dependent properties of rocks and their application in structural design, static and dynamic elastic constants of rocks, rock mass classification methods. Selection excavator based on rock properties.

UNIT III- In-Situ Stresses and Theories of Failure: In-situ stresses and instrumentation, drilling and blasting, measurement of stresses, strains, deformations, in-situ stress determination, strata monitoring in underground and opencast mines, mechanics a of drilling and blasting, blast vibration and its monitoring. Different theories of rock failure and their applications in design of mining structures.

UNIT IV - Design of Underground Openings, Subsidence, Rock Burst and Slope Stability: Design of single and multiple underground openings, pillars including shaft pillar, scaling factors, mining subsidence, rock burst, design of slopes and spoil banks, slope stability in rock & soil and its analysis, slope monitoring and stabilisation techniques. Design of pillars including barrier and shaft pillars.

UNIT V -Design of Mine Supports: Advances of mine supports, supports and bord and pillar and longwall workings, rock load assessment, design of different types of supports like conventional and non-conventional supports like shotcrete, fibre reinforced shotcrete, strata grouting, rock bolting, supports in tunnels and shafts,

Text Books:

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley and Sons Inc., New York, 1967.
2. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78

Reference Books

1. Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.
2. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
3. Hoek, E., and Brown, S.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MINE PLANNING AND DESIGN					

UNIT – I- Introduction: Technical factors in mine planning, methodology of mine planning, short range & long range, mine modelling, mine simulation systems approach to mine planning based on mine subsystem and their elements, mine plan generation.

UNIT – II- Open Pit Mining: Selection of initial mine cuts, location of surface structures, division of mining area into blocks, mine design, bench drainage, geometry, haul roads, slope stability; open pit limits and optimisation, calendar plan, production planning, production scheduling, economic productivity indices.

UNIT – III- Underground Mining: Location of mine entries, mine and auxiliary, optimisation of mine parameters, design of shaft pillars and protective pillars, planning of production capacity, layout of development drives / raises / winzes etc, length of faces, size of panels, etc, planning of support systems, ventilation, lay out of drainage system, planning production schedule and monitoring, selection of depillaring / stopping method, manpower management, economic/ productivity indices, techno economic analysis, mine reclamation design.

UNIT – IV- Equipment Planning: Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment for different mining conditions. Equipment design for optimum drilling and blasting operations. Equipment information – performance, monitoring and expert systems. Innovative mining systems.

UNIT – V- Project Implementation and Monitoring : Pre-project activities – feasibility report, environment clearance, detailed project, report, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Environmental impact assessment and preparation of environmental management plan. Mine closure plan.

Text Books:

1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995.

Reference Books:

1. Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.
2. Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier,1993.
3. Passamehtoglu, A.G., Karpuz, C., Eskikaya, S. and Hizal, T., (Eds), Mine Planning and Equipment Selection, Elsevier, 1994.
4. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.
5. Swilski, and Richards, Underground Hard Coal Mines, Elsevier, 1986.
   Singh, B. and Pal Roy, P., Blasting in Underground excavations and mines, CMR Dhanbad, 1993.

M.Tech - I Sem		L	T	P	C
		3	0	0	3
GROUND IMPROVEMENT TECHNIQUES					

UNIT – I -General : Formation of rock, soils and soil profiles, soil distribution in India and other countries - marine, black cotton soils (expansive)., lateritic, alluvial, desert soils peat etc., factors affecting the alteration of ground after formation – natural and man-made – reclaimed soils – methods of geotechnical processes.

UNIT – II - Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vigor compaction methods, vibro-probes, stone columns, sand compaction, stone column piles, selection of methods – quality control – specifications for compaction process for solving field problems.

UNIT – III -Drainage methods: seepage, ground water seepage control – filter requirements methods of dewatering – well point methods of discharge computations – design of steps for dewatering – design of well screens – selection of pumps and accessories – deep bored wells.
Pre compression methods: compressibility and consolidation properties of soils estimation of rate of consolidation settlements – accelerating methods – monitoring compressions – design of vertical drains – consolidation by electro osmosis and vacuum compression methods.

UNIT – IV -Grouting and injection methods: principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

UNIT – V -Stabilization methods: mechanical, cement, lime, chemical methods of stabilization of soils – use of admixtures – polymers – geo synthesis – reinforcements thermal slurry trenches, void filling – prewetting – improving rock stability methods – exercise quality control to achieve desired results.

Text Books

1. J.E. Bowles – Foundation Design & Analysis.McGraw-Hill Edition 1995.
2. Ground improvement techniques by P. Purushottam Raj, Laxmi Pub., 1999.

Reference Books:

1. F. S. Fang Handbook of Foundation Engg. CBS Pub., 1985.

M.Tech - I Sem		L	T	P	C
		3	0	0	3

TUNNELING AND UNDERGROUND SPACE TECHNOLOGY

UNIT I - Introduction: Congestion in cities and its impact on development of social infrastructure for transport, water and power supply, separation of pedestrian and motorized vehicles and its movements, storage of materials, defence facilities including civil shelters. Parameters influencing location, shape and size; geological aspects; planning and site investigations. Natural caves, archaeological caves and their construction; Scope and application, historical developments, art of tunnelling, tunnel engineering, Tunnels for various purposes like road, rail, hydropower tunnels and caverns, Underground storage for LPG and crude oil, Nuclear waste disposal, Metro tunnels, future tunnelling considerations. Planning and design, Assessment of behaviour of tunnelling media, deformation modulus and rock pressure assessment; determination of appropriate size and shape; Design of openings in rocks with the help of field data; Instrumentation and monitoring; Numerical modelling to assess the stability.

UNIT II -Tunnelling Methods: Types and purpose of tunnels; factors affecting choice of excavation techniques; soil and rock sampling and testing, Methods - soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

UNIT III - Tunnelling by Drilling and Blasting: Unit operations in conventional tunnelling; Drilling - drilling principles, drilling equipment, drilling tools, drill selection, specific drilling, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts - fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

UNIT IV - Tunnelling by Roadheaders, Impact Hammers and Tunnel Boring Machines: Cutting principles, method of excavation, selection, performance, limitations and problems. Boring principles, method of excavation, selection, performance, limitations and problems; Road headers, Impact Hammers, Tunnel Boring Machines and applications.

UNIT V - Tunnel Surveying, Supports and Services: Surveying in Tunnels: Topographic and geological survey, Methods of surveying and different instruments used for surveying in tunnels, Supports in Tunnels: Principal types of supports, their design and applicability. Steel supports, rock bolts, shotcrete, wire mesh, chain link fabric and fibre reinforced shotcrete and other ground consolidation/grouting techniques. Ground Treatment in Tunnelling: Adverse ground conditions and its effect on tunnelling; introduction to ground control. Supports in Metro tunnels, Tunnel Services and Hazards: Ventilation, drainage and pumping. Explosion, flooding, chimney formation, squeezing ground.

Text Books:

1. Hudson, J.A., Rock Engineering Systems Theory and Practice, Ellis Horwood, England.
2. Clark G.B., (1987), Principles of Rock Fragmentation, john Wiley and Sons, New York.

Reference Books:

1. Lohanson, John and Mathiesen, C.F., Modern trends in Tunnelling and Blast Design, AA Balkima, 154 P, 2000.
2. Bickel J.O., Kuesel T.R. and King E.H., Tunnel Engineering Hand Book, Chapmen & Hill Inc., New York and CBS Publishers, New Delhi 2nd addition.

M.Tech - I Sem		L	T	P	C
		3	0	0	3

MODERN SURVEYING TECHNIQUES

UNIT I -Fundamentals of Total Station and Electromagnetic Waves: Types and working principles of Machines, Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI. Care and Maintenance of total stations.
Electro-optical system: working principle, Sources of Error, Infrared and Laser Total Station instruments. COGO functions, offsets and stake out-land survey applications.

UNIT II -Satellite, GPS System and Data Processing: Basic concepts of GPS, GNSS, IRNSS and GAGAN - Different segments - space, control and user segments - satellite configuration – GPS signal structure, Anti Spoofing and Selective Availability - GPS receivers. Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -satellite geometry & accuracy measures - applications.

UNIT III -Mine and Cadastral Surveying: Reconnaissance – Route surveys for highways, railways and tunnels –Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out – Transfer of azimuth – Gyro Theodolite – Shafts and audits - Cadastral survey- Legal – Real – Tax cadastre – Land record system – Settlement procedure – deformation studies. Mine plan preparation - mapping process - use of mapping softwares, VAVIks mapping.
Route surveys of water ways, Hydrographic survey Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge.

UNIT IV -Airborne Laser Scanners: Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser – First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of a Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software. Merits of ALS in comparison to Levelling, echo sounding, GPS levelling, Photogrammetry and Interferometry

UNIT V -Data Acquisition, Pre and Post Processing : Various Scanning Mechanism – Synchronization of GPS, IMU and ALS Data - Reflectivity of terrain objects – Laser Classification – Class I to Class IV Laser – Eye Safety. Ground Point filtering – Digital Surface Model and Digital Elevation Model. Overview of LIDAR Applications in various domains - 3D models – Corridor Mapping Applications – Forestry Applications. Terrestrial Laser Scanners (TLS) – Working Principle – Commercial TLS Specifications – Applications of TLS, Drone based Mapping - derivatives from drone surveying.

Text Books

1. Satheesh Gopi, Rasathishkumar, N.Madhu, – Advanced Surveying, Total Station GPS and Remote Sensing – Pearson education , 2007 ISBN: 978-81317 00679 52.
2. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.

Reference Books:

1. Jie Shan and Charles K. Toth, Topographic Laser Ranging and Scanning – Principles and Processing, CRC Press, Taylor & Francis Group, 2009.
2. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1996.
3. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing , 2013.
6. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

M.Tech - I Sem		L	T	P	C
		3	0	0	3

INSTRUMENTATION IN MINING

UINT I -Electrical Instruments: Basic Concepts: Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation. Accuracy, precision, resolution, sensitivity, linearity, span and range - Dynamic characteristics. Ammeters (MI & MC), Volt meters, Watt meters (Dynami), Energy Meters, Megger, Power Factor meters, Earth resistance measurement. and thermocouples, Inclinometers

UINT II -Pressure Measurements and Flow Measurements: Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges and sensors– Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge, deformation gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge. Piezometer, Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rotameter – Mass flow meters.

UNIT III -Vibration, Humidity, Velocity and Level Measurements: Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer – Vibrometers – Geo-phones. Humidity – Hot wire electro type hygrometer – Dew cell – Electrolysis type hygrometer. Anemometer, Velometer, Pitot static tube, Sound level meter, microphone, Lux meter; Level measurements: – Float gauges - Displacer type – D/P methods -Bubbler system- Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method -Solid level measurement.

UNIT IV -Analysers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium analyser – Silica analyser – Turbidity meter – Gas analyser – O_2, NO_x – H_2S analyser – CO and CO_2 monitor, Dust & Smoke measurement. IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Calibration methods.

UNIT V -Rock Mechanics Instrumentation: Different types of Load cells, stress capsules, Flat jack, tape extensor meters, convergence indicators and recorders, borehole deformation gauges of different types, depth indicators. Seismic measurements, Applications in Mining**:** Coal mining – bord and pillar development, depillaring and Long wall, Metal mining and opencast mining applications, rock slope instrumentation.

Text/ Books

1. De, N.K. and Sen, P.K. ‘Electric Drives’ Prentice Hall of India Private Ltd, 2002.
2. Subramaniam, V. ‘Electric Drives’ Tata McGraw Hill , New Delhi,2007

Reference Books:

1. Dubey, G.K. ’Fundamentals of Electrical Drives’ Narosa, Second Edition.
2. Morrris, A.S. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999.
3. Doeblin, E.O. Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999.

M.Tech - I Sem		L	T	P	C
		3	0	0	3
INTRODUCTION TO ROBOTICS AND APPLICATION TO MINING					

UNIT-I -Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II - Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

UNIT – III - Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems. Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

UNIT – IV - Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

UNIT – V - Robot Application in Mining: Mining cycles such as drilling, blasting, loading, transportation in opencast mines; and its application in underground mining methods board and pillar, blasting gallery, continuous miner and long wall, Mine ventilation: mine gas monitoring, ventilation survey and others. Rescue and recovery works.

Tex Books

1. Mikell PG, Mitchel W, Roger NN, Nicholas GO and Ashish D. Industrial Robotics: Technology, Programming and Applications. Pearson Edu.
2. Mittal R K and Nagrath I J. Robotics and Control. Tata McGraw-Hill Education Pvt Ltd. 2003.

References Books:

1. Richard DK, Thomas AC and Michael N. Robotic Engineering: An Integrated Approach. Prentice Hall. 1989.

M.Tech - I Sem		L	T	P	C
		3	0	0	3
REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM					

UNIT-I - Basic principles of Remote Sensing: Definition and components, Electro Magnetic Radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Black body radiation; Reflectance; spectral reflectance of land covers.

UNIT-II - Sensors and platforms: Types of sensors: Multispectral, Hyper-spectral, Microwave, scanners-along track and across track; Platform and their types-Geostationary and Polar orbiting, platforms based on altitudes. Satellite missions–MODIS, IRS, LANDSAT, SPOT, marine/ocean observation satellites.

UNIT-III - Digital Image Processing (DIP): Interpretation of Images; Registration: Transfer of Information from Imagery to Base Map; Classification; Exposure to various Image Processing Techniques and Generation of digitally processed outputs.

UNIT-IV - Geographical Information System (GIS): Definitions, History and development of GIS, components of GIS, applications of GIS; Coordinate Systems - Geographical Coordinate Systems, Projected Coordinate System, map projections; Geospatial data - Data input-existing GIS data, creating new data; attribute data query, spatial data query, raster data query.

UNIT – V - Applications: Recent trends in RS&GIS and Environmental assessment & monitoring, Land Use and Land cover classification, Vehicle tracking system, Application of Geo-statistical methods and GIS in mineral prospecting and ore reserve estimation, Applications of GPS in Mineral Resource Surveys, Mapping and Navigation. Role of DGPS surveys in mining leases and identifying illegalities.

Text Books

1. Anji Redddy M. Remote sensing and geographical information systems. 3rd edition. 2008.
2. Kaplan ED. Understanding GPS: principles and application. British Library Catalogue. 2006

Reference books:

1. Lillesand TM and Kiefer RW. Remote sensing and image interpretation. John Wiley and Sons, New York, 2004.
2. ML and Chouhan TS. Remote sensing and photogrammetry: principles and applications. Vigyan Prakashan, Jodhpur. 1998.

M.Tech - I Sem		L	T	P	C
		0	0	4	2
ROCK MECHANICS LAB					

1. Sample collection and Specimen preparation.
2. Determination of moisture content, density, voids ratio and porosity of rocks.
3. Determination of compressive strength, modulus of elasticity and poisson's ratio of rocks.
4. Determination of tensile strength of rocks.
5. Determination of shear strength, angle of internal friction and cohesion of soil.
6. Determination of point load strength index of rocks.
7. Determination of protodyknov's strength index of rocks.
8. Determination of slake durability index of rocks.
9. Determination of cohesion and angle of internal friction of rocks using triaxial test.
10. Determination of hydraulic conductivity of sand.

M.Tech - I Sem		L	T	P	C
		0	0	4	2
MINE PLANNING AND DESIGN LAB					

1. Estimation of reserves of coal and metaliferous deposits.
2. Design of the haul roadway of open pit mines.
3. Design of the surface mine.
4. Design of underground coal mine.
5. Design of mine ventilation system for board and pillar method.
6. Design of mine ventilation system for long wall panel.
7. Design of blast for open pit workings.
8. Design of blast for cast blasting technique.

I Year - I Semester		L	T	P	C
		2	0	0	2
RESEARCH METHODOLOGY AND IPR					

UNIT 1:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 3:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

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

I Year I Semester	Writing Skills For Scientific Communication	L	P	C
		2	0	0

Unit-1:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness**,** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising.

Unit-2: Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit-3:
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-4:
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Unit-5:
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

COURSE OUTCOMES: The Students will be able to
CO1. Understand that how to improve your writing skills and level of readability
CO2. Learn about what to write in each section
CO3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission