

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08 CE6211	<b>AIRPORT INFRASTRUCTURE PLANNING AND DESIGN</b>	3-0-0 (3)	
<b>Course Objectives</b>			
To give the Student:-			
<ol style="list-style-type: none"> <li>1. Concept of planning and designing of airport</li> <li>2. Knowledge of air traffic controlling measures and techniques</li> <li>3. Engineering knowledge on structural and geometric design of airport</li> </ol>			
<b>Syllabus</b>			
Aircraft characteristics Air traffic management Airport planning and forecasting Airport lighting, markings and signs Planning and design of terminal area Structural design of airport pavement			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. Analyze the effects of atmospheric variables on aircraft performance.</li> <li>2. Fix the orientation of the runways.</li> <li>3. Design the geometrics of the airport infrastructure.</li> <li>4. Prepare structural designs of runway, taxiway, and apron-gate area.</li> <li>5. Prepare a master plan for an airport.</li> <li>6. Prepare a plan of the airport terminal area.</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York, 1996</li> <li>2. Robert Horonjeff, Francis McKelvey, William Sproule, Seth Young, Planning and Design of Airports, Fifth Edition, McGraw Hill Professional, 2010.</li> <li>3. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York, 2003</li> <li>4. Airport Planning and Systems – <a href="http://airportssystems.com/Course/index-html">http://airportssystems.com/Course/index-html</a></li> <li>5. S.K.Khanna and M.G.Arora, "Airport Planning and Design", Nem Chand and Bros, 1999.</li> <li>6. Norman. J. Ashford, Sakleh.A Mumayiz and Paul. H. Wright, "Airport Engineering Planning Design and Development of 21st Century Airports, 5<sup>th</sup> Edn. John Wiley and sons, New Jersey, 2011.</li> <li>7. Subhash C. Saxena, Airport Engineering: Planning &amp; Design, CBS Publishers &amp; Distributors, 2008.</li> </ol>			

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<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	
08 CE6211	<b>AIRPORT INFRASTRUCTURE PLANNING AND DESIGN</b>	<b>3-0-0 (3)</b>	
<b>Modules</b>	<b>Content</b>	<b>Contact Hours</b>	<b>Semester Exam Marks (%)</b>
I	<b>Aircraft Characteristics:</b> Landing gear configurations, aircraft weight, engine types. Atmospheric conditions affecting aircraft performance: air pressure, temperature, wind speed and direction. Aircraft performance characteristics: speed, payload and range, runway performance, declared distances, wingtip vortices.	<b>6</b>	<b>15</b>
II	<b>Air Traffic Management:</b> Air traffic separation rules: vertical separation, flight altitudes, longitudinal separation, and lateral separation. Navigational aids: ground based systems, satellite based systems. <b>Airport Planning and Forecasting:</b> Airport planning studies: airport system plan, airport site selection, airport master plan, airport project plan. Forecasting methods: time series method, market share method, econometric modelling. Forecasting requirements and applications: airport system plan, airport master plan.	<b>8</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
III	<b>Airport Lighting, Marking, and Signage:</b> Requirements of visual aids, approach lighting system configurations, visual approach slope aids, threshold lighting. Runway lighting, taxiway lighting. Runway and taxiway marking, airfield signage.	<b>6</b>	<b>15</b>
IV	<b>Planning and Design of the Terminal Area:</b> Passenger terminal system and its components. Design considerations: terminal demand parameters, facility classification, level of service criteria. Terminal planning process: overall space requirements, concept development, horizontal distribution concepts, vertical distribution concepts. Apron gate system: number of gates, ramp charts, gate size, aircraft parking type, apron layout, apron circulation, passenger conveyance to aircraft, apron utility requirements.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
V	<b>Geometric Design of the Airfield:</b> Airport classification: utility airports, transport airports.	<b>8</b>	<b>20</b>

	Runways: runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, airfield separation requirements, obstacle clearance requirements. Taxiways and taxilanes: widths and slopes, taxiway and taxilane separation requirements, sight distance and longitudinal profile, exit taxiway geometry, location of exit taxiways, design of taxiway curves and intersections, end-around taxiways. Aprons: holding aprons, terminal aprons and ramps, terminal apron surface gradients. Control tower visibility requirements.		
VI	<p><b>Structural Design of Airport Pavements:</b> Soil investigation and evaluation: CBR, plate bearing test, Young's modulus, effect of frost on soil strength, subgrade stabilization. FAA pavement design methods: equivalent aircraft method, cumulative damage failure method.</p> <p><b>Design of flexible pavements:</b> CBR method, layered elastic design. Design of rigid pavements: Westergaard's analysis, finite element theory, joints and joint spacing, continuously reinforced concrete pavements. Design of pavement overlays.</p>	8	20
END SEMESTER EXAM			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08 CE6213	<b>MASS TRANSPORTATION PLANNING</b>	3-0-0 (3)	
<b>Course Objectives</b>			
To give the Student:-			
1. An understanding of importance of Public Transportation and its planning concept 2. Contemporary knowledge about the components of Transit operations and its pricing 3. Ability to plan transit route network based on the passenger demand			
<b>Syllabus</b>			
Transit system: Types and characteristics, Estimation of transit demand, Bus route network planning, Scheduling, Mass transit corridor identification & planning, Mass transport management measures, Bus stops and terminal designs.			
<b>Course Outcome</b>			
1. Ability to estimate transit demand and plan and schedule public transport network 2. Ability to identify and plan transit corridors 3. Ability to propose suitable Transport management measures			
<b>References</b>			
1. Black, A. Urban Mass Transportation Planning, McGraw-Hill International Enterprises, Inc. 1995. 2. David A. Hensher, Bus Transport: Economics, Policy and Planning. Research in Transportation Economics Volume 18. Elsevier Publications, 2007. 3. G.E. Gray and CA Hoel: Public Transport Planning Operation and Management, Prentice Hall; 2 <sup>nd</sup> Edition, 1992 4. P. Chakroborty and A. Das, Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd., 2003. 5. Simpson, Barry J., Urban Public Transport Today. Taylor & Francis Routledge Publisher, 2003 6. Susman, J. Introduction to Transportation Systems, Artech House Boston, London, 2000. 7. Tiwari G., Urban Transport for Growing Cities – High Capacity Bus System, MacMillan India Ltd., 2002 8. Tyler N., Accessibility and the Bus System – Concepts and Practice, Thomas Telford, 2002. 9. V.R. Vuchic, Urban Public Transport System and Technology, Prentice Hall Inc 10. Vuchic Vukan R., Urban Transit: Operations, Planning and Economics, Prentice Hall, 2005. 11. White, P., Public Transport: Its Planning, Management and Operation, Fourth Edition, London New York, 2002.			

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COURSE CODE	COURSE NAME	L-T-P (C)	
08 CE6213	MASS TRANSPORTATION PLANNING	3-0-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Transit system:</b> Role of Transit - Types of Transit Modes - Buses - LRT, RTS - Air cushioned and Maglev System – S-Bahn Dual Mode Busses, Para Transit - Dial - a- Ride- Taxi- Jitney and Ridesharing – PRT Networks -DRTS Technological Characteristics – Resistances, acceleration & velocity Profiles – Operational characteristics speed, capacity & payloads – Route capacity – Comfort conditions - Performance relationships - Public and Private Operations - Modes for Intercity Transport.	6	15
II	<b>Estimation of transit demand:</b> Data requirements & Collection techniques, Conventional Methods - Destination Survey - Bus Stop Surveys and Analysis - Mode Split Models - Captive and Choice Riders - Attitudes of Travellers - Patronage Determination.	8	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Bus route network planning:</b> Route Systems - Route Location, Route Structure, Route Coding Techniques, Route Capacity - Planning of Transit Network - Different Types - Service Area Coverage - Evaluation - Selection of Optimal Network - Path Building Criteria - Integration with UTPS.	6	15
IV	<b>Scheduling:</b> Patterns of Bus Services - Frequency of Services - Special Services - Single Route Bus Scheduling - Fleet Requirement, Marginal Ridership Concept - Use of Optimisation Technique - Load Factor - Depot Location - Spacing of Bus Stops	6	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Mass transit corridor identification &amp; planning:</b> Corridor identification - Network Compression Method - Planning of Rapid Transit System - System Selection - Supporting and Enclosing Structures - System Evaluation - Track Structures - Power Supply and Distribution - Signal System - Aesthetics and Noise Consideration - Cost of Construction - Station Arrangements - Platform Capacity - Fare Collection, Transit Marketing.	8	20
VI	<b>Mass transport management measures:</b> RTC Act -	8	20

	<p>ASRTU System Efficiency and Effectiveness Measures - Performance Indicators – LOPTS - Preferential Treatment to HOV: Exclusive Bus Lanes - Bus Streets - Contra Flows - Reversible Lanes - Bus Bypass - Bus Pre-emption Signals for Bus Operations.</p> <p><b>Bus stops and terminal designs:</b> Type Design – Bus stop capacities – Bus Parking patterns at Terminals and Wayside Stations – Integration.</p>		
<p align="center"><b>END SEMESTER EXAM</b></p>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08 CE6215	<b>ROAD SAFETY ENGINEERING</b>	3-0-0 (3)	
<b>Course Objectives</b>			
To give the Student:- 1. The concept of road safety management system 2. knowledge about road safety based design techniques 3. an understanding of methods of road safety audit and crash mitigation measures			
<b>Syllabus</b>			
Road safety management system Analysis and interpretation of crash data Road safety audits Crash reconstruction Crash mitigation measures			
<b>Course Outcome</b>			
1. Analyze the effect of driver characteristics, roadway characteristics, climatic factors on highway safety. 2. Plan and design a road safety improvement program. 3. Analyze accident data and suggest safety measures. 4. Conduct road safety audit. 5. Interpret accident data using statistical analysis.			
<b>References</b>			
1. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002). 2. Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE, 1999. 3. J. Stannard Baker, Traffic Collision Investigation, Northwestern University Center for Public Safety, 2002. 4. Leonard Evans, Traffic Safety, Science Serving Society, 2004. 5. Lynn B. Fricke, Traffic Accident Reconstruction, Northwestern University Center for Public Safety, 1990. 6. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering. Avebury Technical, 1996. 7. Popkess C.A, Traffic Control and Road Accident Prevention, Chapman and Hall, 1997 8. Rune Elvik and Truls Vaa, The Handbook of Road Safety Measures, Elsevier, 2009. 9. Simon Washington, Matthew Karlaftis, and Fred Mannering, Statistical and Econometric Methods for Transportation Data Analysis, Chapman & Hall/CRC Press, 2003. 10. Towards Safe Roads in Developing country, TRL – ODA, 2004 11. M. N. Shreehari, K. V. Ramesh, National Conference on Traffic Engineering and Road Safety in India: problems & prospects, Traffic Engineers & Safety Trainers, 2004. 12. Martin Belcher, Steve Proctor, Phil Cook, Practical Road Safety Auditing, I C E Publishing, 2015 13. Becky P. Y. Loo, Tessa Kate Anderson, Spatial Analysis Methods of Road Traffic Collisions, CRC Press, 2015.			

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COURSE CODE	COURSE NAME	L-T-P (C)	
08 CE6215	ROAD SAFETY ENGINEERING	3-0-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Introduction to safety:</b> Road crashes, Trends, causes, Collision and Condition diagrams, Highway safety, human factors, Vehicle factors	6	15
II	<b>Road Safety Management System:</b> Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs.	6	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Statistical Interpretation and Analysis of Crash Data:</b> Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification & Investigations, Crash data modeling - Case Studies.	6	15
IV	<b>Road Safety Audits:</b> Key elements of a road safety audit, Road Safety Audits & Investigations, Crash investigation and analysis, Describe methods for identifying hazardous road locations, Case Studies. Crash risk assessment programs.	6	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Crash Reconstruction:</b> Describe the basic information that can be obtained from the roadway surface, Understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies.	10	20
VI	<b>Mitigation Measures:</b> Crash prevention by better planning, and better design of roads, Crash Countermeasures, Highway operation and crash control measures, Highway Safety Measures during construction, Highway geometry and safety, Geometric Design Consistency and Safety.	8	20



<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08 CE6217	<b>GROUND EXPLORATION TECHNIQUES</b>	3-0-0 (3)	
<b>Course Objectives</b>			
Objectives: To equip students with techniques of exploration, testing and evaluation for soil parameters required for foundation choice and design			
<b>Syllabus</b>			
Principles of exploration – modern methods of exploration – various field test for soil exploration and its property estimation – sampling techniques – types of samples – methods of evaluation and equipments used in soil engineering – settlement and heave gauges			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. To Understand The Importance Of Ground Exploration Techniques In Civil Engineering Construction Activities.</li> <li>2. To Perform Any Modern Ground Improvement Design Including Soil Stabilization</li> <li>3. Be Able To Plan And Design A Subsurface Exploration Program Based On Anticipated Geologic Conditions And Potential Construction Problems.</li> <li>4. Be Able To Log Rock Core And/Or Soil Samples And Prepare Boring Logs For Civil Engineering Projects.</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Lambe, Soil Testing for Engineers, John Wiley, New York, 1951.</li> <li>2. Goodman R.E., Rock Mechanics, John Wiley, New York, 1988.</li> <li>3. Terzaghi, K. and Peck R.B., Soil Mechanics in Engineering Practice, 3<sup>rd</sup> edition, John Wiley, 1996.</li> <li>4. Murthy V.N.S., Soil Mechanics and Foundation Engineering, CBS, 2009.</li> <li>5. Coduto, Man-chu Ronald Yeung and William A. Kitch, Geotechnical Engineering Principles and Practices, Pearson Education, 2nd edition, 2010.</li> <li>6. Joseph E., and Bowls, Foundation Analysis and Design, McGraw Hill, 2001.</li> <li>7. Tomlinson M J., Foundation Design and Construction, Prentice Hall; 7 edition, 2001.</li> <li>8. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw – Hill International Editions, 1990.</li> <li>9. Purushothama Raj, Ground Improvement Techniques, 2<sup>nd</sup> edition, Laxmi Publications, New Delhi, 2016.</li> <li>10. Sharma. S. K., Principles, Practice and Design of Highway Engineering, S. Chand &amp; Co. New Delhi, 2012.</li> <li>11. Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London 1996.</li> <li>12. J. Russell Boulding, “Subsurface Characterization And Monitoring Techniques”, Diane Publishing, 1996.</li> <li>13. Braja M. Das, Khaled Sobhan, “Principles of Geotechnical Engineering”, SI Edition, 2016.</li> <li>14. Muni Budhu, Soil Mechanics Fundamentals, Wiley Blackwell.2015.</li> <li>15. Dante Fratta, Jennifer Aguetant, Lynne Roussel-Smith “Introduction to Soil Mechanics Laboratory Testing, CRC Press, 2017</li> </ol>			

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<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	
08 CE6217	<b>GROUND EXPLORATION TECHNIQUES</b>	<b>3-0-0 (3)</b>	
<b>Modules</b>	<b>Content</b>	<b>Contact Hours</b>	<b>Semester Exam Marks (%)</b>
I	Principles of exploration; Modern methods of boring and drilling, exploration Techniques, non-displacement and displacement methods, drilling in difficult subsoil conditions, stabilization of boreholes Geophysical Methods – electrical method, seismic method.	7	15
II	Exploration Techniques Accessible exploration and Semi-direct methods, Test pits, Trenches, Shafts Bore holes – Drilling methods, equipments and applicable soil types – Auger boring, Wash boring, Rotary drilling, Percussion drilling Stabilization of boreholes	7	15
<b>FIRST INTERNAL EXAM</b>			
III	Field tests, penetration tests, procedures and methods, data interpretation, field vane shear, In-situ shear and bore hole shear test, pressure meter test, utility, correction and data interpretation, plate load test–monotonic and cyclic; field permeability test.	7	15
IV	Disturbed and undisturbed soil sampling, advanced sampling techniques, offshore sampling, types of samplers, design criteria for samplers, preservation and handling of samples	7	15
<b>SECOND INTERNAL EXAM</b>			
V	Methods and equipments – interpretation of offshore exploration, Instrumentation in soil engineering - strain gauges - resistance and inductance type.	7	20
VI	Load cells, earth pressure cells - settlement and heave gauges - piezometers and slope indicators - inclinometer, case studies, data and report preparation	7	20
<b>END SEMESTE EXAM</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08 CE6219	<b>ENVIRONMENT IMPACT ASSESSMENT OF TRANSPORTATION PROJECTS</b>	3-0-0 (3)	
<b>Course Objectives</b>			
1. Develop a balanced view of the relationship between environment and development 2. Provide an understanding of the basic principles and technical and social limitations of an EIA 3. Develop the skills to conduct an Environmental Impact Study			
<b>Syllabus</b>			
Introduction – Scope and definition of EIA -Legislations, laws and acts relevant to environmental protection in India – National Environment Protection Act - EIA methodologies - formation of EIA team – EIA processes –EIA acts - Application of EIA in Transportation - Assessment and prediction of Impacts on Water Environment, Air environment and noise - Socio-economic Impacts - Environmental Risk Analysis- Energy Impact Analysis- EMP for air and noise environments- – Case studies			
<b>Course Outcome</b>			
1. Students will be able to understand the existing environmental rules and legislations in our country 2. Students will gain basic knowledge and understanding of the role of EIA in environmental management for sustainable develop 3. Students will gain awareness regarding ecologically sustainable development and environmental friendly technologies and also the regulatory provisions for environmental protect			
<b>References</b>			
1. Canter .L.W., Environmental Impact Assessment, McGraw Hill New York 1996. 2. John. G. Rau and David .C. Wooten, Environmental Impact Analysis Hand Book, McGraw Hill, 1980. 3. Petts.J. Hand Book of environmental Impact Assessment, M Land “Blackwell Science London 1999. 4. Suresh K. Dhameja-Environmental Engineering and Management, S.K. Kataria & Sons, 2010. 5. Davis, M.L., and Cornell, D.A. Introduction to Environmental Engineering, Mc Graw Hill International Editions, 1998 6. United Nations. Economic and Social Commission for Asia and Pacific, Multistage Environmental and Social Impact Assessment of Road Projects Guidelines for comprehensive process, New York, 2001. 7. Organisation for Economic Co-operation and Development, Environmental Impact Assessment of Roads, 1994. 8. Betty Marriott, Environmental Impact Assessment: A Practical Guide, McGraw Hill Professional, 1997.			

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08 CE6219	ENVIRONMENT IMPACT ASSESSMENT OF TRANSPORTATION PROJECTS	3-0-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Introduction</b> – Introduction to Environmental Impact Assessment (EIA)- Objectives and Needs- development of EIA - National Environmental Protection Act 1986 – Key features. Rapid EIA – Comprehensive EIA – Strategic EIA- procedure for EIA in India.	6	15
II	<b>EIA methodologies</b> –formulation of EIA team –inter disciplinary approach -Screening – Scoping - checklist, matrix and network methodologies - Identification of Impacts – Collection and documentation of baseline data –Need for Prediction and Mitigation Measures	6	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Application of EIA in Transportation.</b> Public participation in Environmental decision making - techniques for conflict management and dispute resolution in transportation projects. Role of GIS and RS in environmental impact assessment of transportation projects.	6	15
IV	<b>Assessment and prediction of Impacts on Water Environment:</b> Basic water quality, sources and effects of water pollution, assessment and prediction of impacts, Streeter Phelps equation and its application in EIA studies. Mathematical modelling for prediction of water pollution on account of transportation projects, mitigation measures, legislations.	8	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Assessment and prediction of Impacts on Air Environment:</b> air quality, sources and effects of air pollution, assessment and prediction of impacts, Gaussian distribution for air pollution for point and line sources, mitigation measures, legislations. <b>Assessment of Impacts of Noise</b> – Basic information, sources and effects of noise pollution, control measures, legislations	8	20
VI	<b>Socio-economic impacts in EIA studies</b> - Ecological impacts –Ecological foot-prints– Environmental Indices. Introduction to Environmental Management Systems - Cost Benefit Analysis - Environmental Audit - Life cycle	8	20

	Assessment – Environmental Risk assessment – Case studies from India		
<b>END SEMESTER EXAM</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08CE6201	<b>FUNDAMENTALS OF TRAFFIC ENGINEERING</b>	3-0-0 (3)	
<b>Course Objectives</b>			
To give the Student:-			
<ol style="list-style-type: none"> <li>1. Basic concepts of the components of road traffic and its characteristics.</li> <li>2. Idea to conduct, analyse and interpret various traffic surveys.</li> <li>3. An understanding of rules and regulations related to road traffic.</li> <li>4. Ability to design different traffic engineering control systems like signals and traffic islands.</li> </ol>			
<b>Syllabus</b>			
Components and characteristics of Traffic stream: road traffic, vehicle and road user Traffic stream parameters: Fundamental diagrams of traffic flow, PCU concepts Traffic surveys-Data collection and analysis of various traffic parameters Studies on parking, headway, pedestrian, accident and Congestion Application of probability and statistics in traffic Engineering data analysis Traffic controls and regulations, Design of intersections- signals, traffic management measures			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. Ability to understand the various characteristics of elements in traffic engineering.</li> <li>2. Ability to analyse and interpret the significant parameters in traffic scenario.</li> <li>3. Awareness to various traffic control devices and how to implement traffic safety</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Brian Wolshon, Anurag Pande, Traffic Engineering Handbook, Institute of Transport Engineers, 7th Edition, Wiley, 2016.</li> <li>2. Coleman O'Flaherty, Transport Planning and Traffic Engineering, Elsevier, 1997.</li> <li>3. Fred L. Mannering, Scott S. Washburn, Principles of Highway Engineering and Traffic Analysis, 5th Edn., Wiley 2012.</li> <li>4. Roess R P, Mc Shane W R &amp; Prassas E S, Traffic Engineering, Prentice Hall, 3rd edition 2004</li> <li>5. Pignataro L J, Traffic Engineering, Theory and Practice 1983</li> <li>6. A. D. May, Traffic Flow Fundamentals, Prentice Hall, 1990.</li> <li>7. Kadiyali, L R., 'Traffic Engineering and Transport Planning', Khanna Publishers, 2011.</li> <li>8. Matson, Smith and Hurd, 'Traffic Engineering', Mc GrawHill Book Co., 1955.</li> <li>9. Wells, G R, 'Traffic Engineering-An Introduction', Griffin, London 1970.</li> <li>10. Chakraborty Partha, Das Animesh, Principles of Transportation Engineering, PHI Learning Pvt.Ltd., 2009</li> <li>11. R.J. Salter, Highway Traffic Analysis and Design, 2nd Edition, Macmillan, 1989.</li> <li>12. IRC Publications</li> </ol>			

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08CE6201	FUNDAMENTALS OF TRAFFIC ENGINEERING	3-0-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Components of Traffic System:</b> Introduction, Human-vehicle-environment system, Characteristics of road users; Characteristics of vehicles; Characteristics of highways and traffic stream.	5	15
II	<b>Traffic Engineering Data Collection:</b> Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment, Data Collection, (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accident (g) Pedestrian and other Studies.	6	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Traffic Engineering Data Analysis</b> –Data exploration techniques, fitting of distributions, statistical analysis of traffic stream parameters.	9	15
IV	<b>Road safety improvement measures-</b> Traffic laws and ordinances-General regulations-Regulations on vehicles, drivers, pedestrians and traffic-regulations on speed-speed zoning-parking regulations-enforcement of regulations. Road furniture - street lighting, design and analysis -Road safety audit and safety measures, traffic management measures.	10	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Traffic control engineering</b> - Traffic Signs and Road Markings-design of at grade intersections-principles and design- channelization- design of rotaries-traffic signals-pre timed and actuated-design of signal settings (Webster and HCM methods)-phase diagrams, timing diagram- signal co ordination- other traffic control aids	13	20
VI	<b>Traffic Stream Characteristics</b> Microscopic and macroscopic flow characteristics; Time headways, temporal, spatial and flow patterns; Interrupted and un-interrupted traffic; Microscopic and macroscopic speed characteristics; Vehicular speed trajectories; Speed characteristics- mathematical distributions; Speed and travel time variations; travel time and delay studies; Introduction to microscopic and macroscopic density characteristics; distance headway characteristics.	13	20
<b>END SEMESTER EXAM</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08CE6203	<b>PAVEMENT ANALYSIS AND DESIGN</b>	3-0-0 (4)	
<b>Course Objectives</b>			
To give the Student:-			
<ol style="list-style-type: none"> <li>1. Idea about various material used in pavement construction and their properties</li> <li>2. An understanding of load distribution characteristics of flexible and rigid pavements</li> <li>3. The concept of development of stresses and strains within the pavement system</li> <li>4. Knowledge about pavement design methods</li> </ol>			
<b>Syllabus</b>			
<p>Pavement materials – Aggregates, bitumen and cement – properties, grading and testing - Introduction to pavements, sub systems- factors affecting pavement design - Failure criteria for design of pavements - Stresses and strains in flexible pavements, Burmister's layer theory</p> <p>Design of flexible pavements: IRC Method, Asphalt Institute Method, AASHTO Method, Pavement drainage system - Stresses in rigid pavements, Design of rigid pavements: IRC, AASHTO and PCA method</p> <p>Design of continuously reinforced concrete pavements, (IRC method). Introduction to softwares used for design of pavements.</p>			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. Select suitable materials required for flexible and rigid pavement construction.</li> <li>2. Understand the fundamentals of stress distribution within a pavement system</li> <li>3. Ability to analyse the stresses and design pavements with better performance and longer service life</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Athanassios Nikolaidis, Highway Engineering: Pavements, Materials and Control of Quality, CRC press, 2014.</li> <li>2. Richard Kim Y, Asphalt pavements, CRC press, 2014.</li> <li>3. Asphalt Institute. Mix Design Methods – For Asphalt Concrete and Other Hot-Mix Types,</li> <li>4. Manual Series No. 2 (MS-2), Asphalt Institute, Kentucky, USA, 1997.</li> <li>5. R. N. Hunter, Bituminous Mixtures in Road Construction, Thomas Telford Services Ltd 1995.</li> <li>6. Atkins, H.N. Highway Materials, Soils, and Concretes, Reston Publishing Company, Virginia, USA, 4<sup>th</sup> edition, 2002.</li> <li>7. Bland, D.R. The Theory of Linear Viscoelasticity, Pergamon Press, New York, USA, 1960.</li> <li>8. Christensen, R.M. Theory of Viscoelasticity – An Introduction, Academic Press, New York, USA, 1971.</li> <li>9. IRC:44-2008 Guidelines for Cement Concrete Mix Design for Pavements, The Indian Roads Congress, New Delhi, India, 2008.</li> <li>10. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.</li> <li>11. Manual for construction and supervision of Bituminous works, MoRTH 2001.</li> <li>12. Yang H. Huang, Pavement Analysis and Design, 2nd Ed. Prentice Hall, 2003.</li> <li>13. Yoder and Witczak, Principles of Pavement Design, John Wiley and sons, 2007.</li> <li>14. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press, 2013.</li> <li>15. Latest revisions of IRC codes: IRC: 37-2012 and IRC: 58 - 2013.</li> </ol>			



16. T. Papagiannakis, E. A. Masad, Pavement Design and Materials, John Wiley & Sons 2008.
17. David Croney and Paul Croney, The design and performance of Road Pavements, 3rd edition, McGraw-Hill Publishing Co, 1997.

### COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6203	PAVEMENT ANALYSIS AND DESIGN	3-0-0 (4)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Pavement materials:</b> <b>Aggregates</b> - requirements, properties and testing used, aggregate blending to meet specification. <b>Bitumen</b> - Types of bituminous binders. Tests on bitumen, physical properties, specifications for paving bitumen. Rheology of bituminous binders. Grading of bitumen. <b>Bituminous Mixes</b> - Design of bituminous mixes using Marshall method, and SUPERPAVE method. Types of bituminous mixes (HMA, WMA, SMA, etc.) and applications, Dynamic modulus, flow time, flow number, fatigue of bituminous mixes. <b>Cement-</b> grades, chemical composition, properties, admixtures, fibers, properties and testing of pavement quality concrete, high performance concrete	6	15
II	<b>Introduction to Pavements:</b> Types of pavements, Flexible and rigid pavements, Functions of individual layers, Highway and airport pavements <b>Variables Considered in Pavement Design:</b> Traffic factors, Material properties, Climatic effects <b>Traffic Analysis:</b> ADT, AADT, Truck Factor, Growth Factor, Lane Distribution and Vehicle Damage Factor	6	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Stresses and strains in flexible pavements:</b> Stress inducing factors in flexible pavements, Vehicle-Pavement interaction, Stresses and deflections in homogeneous soil mass, Load equivalency factor, Burmister's layer theory: Solutions for one, two and three layered pavement systems.	6	15
IV	<b>Methods of flexible pavement design:</b> Principles of Mechanistic- Empirical Pavement Design (MEPD), Methods of flexible pavement design: IRC Method, Asphalt Institute Method, AASHTO Method.	8	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Stresses in Rigid Pavements:</b> Westergaard's theory and assumptions, Types of stresses: Wheel load stresses,	8	20

	Temperature stresses, Critical combination of stresses. Rigid pavement design methods: IRC method, AASHTO method and PCA method.		
VI	<b>Design of reinforcements in cement concrete pavements</b> Types of joints in cement concrete pavements – functions and requirements Joint spacing – Design of dowel bars and tie bars (IRC method). Introduction to softwares for design of pavements	8	20
<b>END SEMESTER EXAM</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08CE6205	<b>URBAN TRANSPORTATION</b>	3-1-0 (3)	
<b>Course Objectives</b>			
To give the Student:-			
<ol style="list-style-type: none"> <li>1. Concepts of the basic principles of transportation planning.</li> <li>2. Information about latest developments taking place in transportation planning of urban areas and cities.</li> <li>3. Better analytical skill and logical thinking of students</li> </ol>			
<b>Syllabus</b>			
Urban Transportation Planning Process and concepts – transportation problems and solutions, Systems framework of planning Methods of travel demand estimation - Sequential, Recursive and Simultaneous Process, zoning Four stage planning process – Trip generation, trip distribution, mode split and route split Land use Transportation Modeling			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. Ability to plan a transportation system for an urban area, if the necessary input are given</li> <li>2. Improvement in the contemporary knowledge of planning</li> <li>3. Enhancement in analytical skill as well as problem solving and optimizing ability.</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. Khanna.S.K and Justo.C.E.G., Highway Engineering, 9<sup>th</sup> edition, Nemchand and Bros.2011.</li> <li>2. Kadiyali, L R., 'Traffic Engineering and Transport Planning', Khanna Publishers, 2011.</li> <li>3. Hutchinson B.G., Principles of Urban Transportation System Planning, Scripta Book Company, 1974.</li> <li>4. Khisty C.J., B. Kent Lall, Transportation Engineering - An Introduction, Prentice Hall, 2003.</li> <li>5. Bruton M.J., Introduction to Transportation Planning, Hutchinson of London.1975.</li> <li>6. Papacostar, Fundamentals of Transportation Planning, Tata McGraw Hill</li> <li>7. C. S. Papacostas, Panos D. Prevedouros, Transportation Engineering and Planning, Prentice Hall, 2001.</li> <li>8. Dicky J.W., Metropolitan Transportation Planning, Tata McGraw Hill, 1980.</li> <li>9. Mayer M and Miller E, Urban Transportation Planning: A decision oriented Approach, McGraw Hill Primis, 2010.</li> <li>10. Prabir Kumar Sarkar, Vinay Maitri, G. J. Joshi, Transportation Planning Principles, Practices and Policies, PHI Learning Pvt. Ltd., Delhi, 2015.</li> <li>11. D. Johnson Victor, S. Ponnuswamy, Urban Transportation: Planning, Operation and Management, Tata Mc Graw Hill, 2012.</li> <li>12. Steven Avery Smith, Guidebook for Transportation Corridor Studies: A Process for Effective Decision Making, NCHRP Report 435, Transportation Research Board, National Academy Press 1999.</li> </ol>			

### COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08CE6205	URBAN TRANSPORTATION	3-1-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	<b>Urban Transportation Planning Process &amp; Concepts:</b> Role of Transportation and Changing Concerns of Society in Transportation Planning; Transportation Problems and Problem Domain; Objectives and Constraints; Flow Chart for Transportation Planning Process- Inventory, Model Building, Forecasting and Evaluation Stages, Planning in System Engineering Framework; Concept of Travel Demand and its Modelling based on Consumer Behaviour of Travel Choices- Independent Variables, Travel Attributes.	8	15
II	<b>Methods of Travel Demand Estimation:</b> Assumptions in Demand Estimation- Sequential, Recursive and Simultaneous Process - Introduction to Transportation Planning Practices; Definition of Study Area, Zoning. <b>Trip Generation Analysis:</b> Trip Generation Models- Zonal Models, Category analysis, Household Models, Trip Attractions of Work Centres & Commercial Trips.	8	15
<b>FIRST INTERNAL EXAM</b>			
III	<b>Trip Distribution Analysis:</b> Trip End and Trip Interchange Models; Trip Distribution Models - Growth Factor Models - Fratar and Furness models. Gravity Models, Opportunity Models and their calibration; Estimation of Travel Demand based on link volume philosophy.	6	15
IV	<b>Mode Split analysis:</b> Mode Split Analysis- Mode Choice Behaviour, Competing Modes, Mode Split Curves, Probabilistic Models and Two Stage Mode Split Analysis;	6	15
<b>SECOND INTERNAL EXAM</b>			
V	<b>Route Split Analysis-</b> Elements of Transportation Networks, Coding, Minimum Path Tress, Diversion Curves, All-or-Nothing Assignment, Capacity Restrained Assignment, Multipath Assignment	6	20
VI	<b>Traffic corridors:</b> Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis	8	20

	Role of GIS in Land Use and Transportation Planning. Introduction to transport planning software.		
<b>END SEMESTER EXAM</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08CE6291	<b>SEMINAR – I</b>	0-0-2 (2)	
<b>Course Objectives</b>			
<p>To enable the students:</p> <ol style="list-style-type: none"> <li>1. To Identify the current topics in the specific stream.</li> <li>2. To Collect the recent publications related to the identified topics.</li> <li>3. To Do a detailed study of a selected topic based on current journals, published papers and books.</li> <li>4. To Present a seminar on the selected topic on which a detailed study has been done.</li> <li>5. To Improve the writing and presentation skills</li> </ol>			
<b>Approach</b>			
<p>Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.</p>			
<b>Course Outcome</b>			
<p>Upon successful completion of this course, students will be able to</p> <ol style="list-style-type: none"> <li>1. Get good exposure in the current topics in the specific stream.</li> <li>2. Improve the writing and presentation skills.</li> <li>3. Explore domains of interest so as to pursue the course project.</li> </ol>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>
08CE6293	<b>PAVEMENT ENGINEERING LAB</b>	0-0-2 (2)
<b>Course Objectives</b>		
To give the Student:-		
<ol style="list-style-type: none"> <li>1. Knowledge to conduct different test for testing the suitability of various sub-grade soil and aggregates used for pavement construction</li> <li>2. Ability to test the properties of bitumen and various mix for use under different climatic conditions and type of pavement construction</li> <li>3. Principles of design a bituminous mix and to assess the strength and flexibility of given mix.</li> </ol>		
<b>Syllabus</b>		
Tests on soil, Tests on aggregates, Tests on cement concrete, Tests on bitumen and bituminous mixes, Pavement evaluation		
<b>Course Outcome</b>		
<ol style="list-style-type: none"> <li>1. Knowledge about various properties required for different types of pavement constructions</li> <li>2. Knowledge about selection of different pavement construction materials based on the properties.</li> </ol>		
<b>References</b>		
<ol style="list-style-type: none"> <li>1. S.K. Khanna &amp; C.E.G. Justo. Highway Engineering 9<sup>th</sup> edition, New Chand &amp; Brothers, 2011.</li> <li>2. S.K. Khanna &amp; C.E.G. Justo. Highway material Testing, 1969.</li> <li>3. IRC: SP: 19; 2001, Manual For Survey, Investigation &amp; Preparation of Road Projects.</li> <li>4. IRC:81-1997, Guidelines for Strengthening of Flexible Road Pavement using Benkelman beam Deflection Technique.</li> <li>5. Khanna, S.K., Justo, C.E.G. and A. Veeraragavan Highway Materials and Pavement Testing, Nem Chand and Bros, Roorkee, India, 2013.</li> <li>6. Huang, Y.H. Pavement Analysis and Design, Pearson Prentice Hall, New Jersey, USA, 2004.</li> <li>7. Duggal, Ajay K., Puri, Vijay P.,” Laboratory Manual in Highway Engineering” New Age International (P) Limited, Publishers, New Delhi 1991.</li> </ol>		



### List of Experiments

Minimum of any 10 experiments covering any FIVE major categories

SI No.	Name of Experiment
<b>A</b>	<b>Tests on soil</b>
1	Attenberg limits
2	Soil classification
3	Compaction test
4	California Bearing Ratio test
<b>B</b>	<b>Tests on Aggregates</b>
1	Shape test
2	Aggregate impact test
3	Los Angeles abrasion test
4	Stripping value
<b>C</b>	<b>Tests on Cement Concrete</b>
1	Normal Consistency Test
2	Sp. Gravity Test on Cement
3	Fineness test
4	Compressive strength of Cement
5	Tests on Fresh concrete-Workability
6	Tests on Fine Aggregates- Bulking of sand
<b>D</b>	<b>Tests on Bitumen</b>
1	Penetration test
2	Viscosity test
3	Softening point test
4	Specific Gravity
5	Flash and fire point test
6	Ductility test
7	Test on bitumen emulsion and cut back bitumen
<b>E</b>	<b>Test on bituminous Mixes</b>
1	Marshall Mix design and stability test
2	Indirect tensile strength test
3	Rut wheel test
4	Preparation and test on cold mixes
5	Bitumen extraction test
<b>F</b>	<b>Pavement evaluation</b>
1	Roughness measurement
2	Benkelman beam deflection studies and Analysis

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08GN6001	<b>RESEARCH METHODOLOGY</b>	0-2-0 (2)	
<b>Course Objectives</b>			
To enable the students: <ol style="list-style-type: none"> <li>1. To get introduced to research philosophy and processes in general.</li> <li>2. To formulate the research problem and prepare research plan</li> <li>3. To apply various numerical /quantitative techniques for data analysis</li> <li>4. To communicate the research findings effectively</li> </ol>			
<b>Syllabus</b>			
Introduction to Research Methodology-Types of research- Ethical issues- Copy right-royalty-Intellectual property rights and patent law-Copy left- Open access- Analysis of sample research papers to understand various aspects of research methodology: Defining and formulating the research problem-Literature review-Development of working hypothesis- Research design and methods- Data Collection and analysis- Technical writing- Project work on a simple research problem			
<b>Course Outcome</b>			
Upon successful completion of this course, students will be able to <ol style="list-style-type: none"> <li>1. Understand research concepts in terms of identifying the research problem</li> <li>2. Propose possible solutions based on research</li> <li>3. Write a technical paper based on the findings.</li> <li>4. Get a good exposure to a domain of interest.</li> <li>5. Get a good domain and experience to pursue future research activities.</li> <li>6. Prepare a thesis or a technical paper, avoid fallacious arguments and present or publish them</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. C. R. Kothari, Research Methodology, New Age International, 2004</li> <li>2. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2012.</li> <li>3. J. W. Bames, Statistical Analysis for Engineers and Scientists, Tata McGraw-Hill, New York.</li> <li>4. Donald Cooper and Pamela Schindler , Business Research Methods, 12<sup>th</sup> edition, Tata McGraw-Hill, New Delhi, 2014.</li> <li>5. Leedy P. D., Practical Research: Planning and Design, 11th edition, McMillan Publishing Co. 2016.</li> <li>6. Day R. A. and Barbara Gastel, How to Write and Publish a Scientific Paper, Greenwood Press, 2011.</li> <li>7. Manna, Chakraborti, Values and Ethics in Business Profession, Prentice Hall of India, New Delhi, 2012.</li> <li>8. Sople, Managing Intellectual Property: The Strategic Imperative, Prentice Hall of India, New Delhi, 2012.</li> <li>9. Michael C Labossiere, "42 Fallacies", Create Space Independent Publishing Platform, ISBN :1482753936, 9781482753936, 2013.</li> </ol>			

### COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08GN6001	RESEARCH METHODOLOGY	0-2-0 (2)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	Introduction to Research Methodology: Motivation towards research - Types of research: Find examples from literature. Professional ethics in research - Ethical issues-ethical committees. Copy right - royalty - Intellectual property rights and patent law – Copy left-Open access -Reproduction of published material - Plagiarism - Citation and acknowledgement. Impact factor. Identifying major conferences and important journals in the concerned area. Collection of at least 4 papers in the area.	5	-
II	Defining and formulating the research problem - Literature Survey- Analyze the chosen papers and understand how the authors have undertaken literature review, identified the research gaps, arrived at their objectives, formulated their problem and developed a hypothesis.	4	-
<b>FIRST ASSESSMENT</b>			
III	Research design and methods: Analyze the chosen papers to understand formulation of research methods and analytical and experimental methods used. Study of how different it is from previous works. Thesis writing, reporting and presentation: significance of report writing— principles of thesis writing-different steps in report writing - Interpretation in writing – techniques of interpretation – precautions in interpretation - avoiding logical fallacies - format of reporting - – layout and mechanics of research report - references – tables – figures – conclusions – oral presentation – preparation – making presentation – use of visual aids - effective communication - preparation for and presentation in seminars and conferences	4	-
IV	Data Collection and analysis. Analyze the chosen papers and study the methods of data collection used. - Data Processing and Analysis strategies used – Study the tools used for analyzing the data.	5	-
<b>SECOND ASSESSMENT</b>			
V	Technical writing - Structure and components, contents	5	-

	of a typical technical paper, difference between abstract and conclusion, layout, illustrations and tables, bibliography, referencing and footnotes- use of tools like Latex.		
VI	Identification of a simple research problem – Literature survey- Research design- Methodology –paper writing based on a hypothetical result.	<b>5</b>	-
<b>END SEMESTER ASSESSMENT</b>			

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P (C)</b>	<b>2017</b>
08MA6201	<b>APPLIED STATISTICS AND PROBABILITY</b>	3-1-0 (3)	
<b>Course Objectives</b>			
To give the Student:-			
<ol style="list-style-type: none"> <li>1. Knowledge regarding the fundamental concepts, theories of Probability distributions.</li> <li>2. Idea to evaluate a data sequence using the principles of time series analysis.</li> <li>3. Ability to develop regression models for the statistical data</li> <li>4. Ability to conduct statistical test for checking various hypothesis and derive conclusions.</li> </ol>			
<b>Syllabus</b>			
Probability distributions-discrete and continuous-standard distributions-fitting of distributions-Sampling techniques-statistical inference-estimation and testing of hypothesis-regression analysis-Analysis of variance - Completely randomized designs -Randomized block designs. Latin Squares, Factorial experiments, Graphical presentation techniques. Time series models-covariance matrix and principal components			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. Understand and Analyse probability distributions</li> <li>2. Carry out multivariate data analysis and identify correlations</li> <li>3. Develop Time Series Models</li> <li>4. Estimate Parameters using appropriate techniques</li> <li>5. Test hypothesis using goodness of fit measures</li> <li>6. Apply the knowledge in conducting statistical analysis and drawing inferences</li> </ol>			
<b>References</b>			
<ol style="list-style-type: none"> <li>1. George C. Runger Douglas C. Montgomery, Applied Statistics and Probability for Engineers, 6ed, Wiley student edition, 2016</li> <li>2. Gupta S.C. and Kapoor V.K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons,1978.</li> <li>3. Benjamin Jack R. and Comell C.Allin, Probability Statistics and Decision for Civil Engineers, Mc-Graw Hill, 1997</li> <li>4. Richard A. Johnson, Miller and Friends, Probablity and Statistics for Engineers, Prentice Hall of India, 2007</li> <li>5. Dallas E Johnson, Applied multivariate methods for data analysis, Thomson &amp; Duxbburg Press, Singapore, 2002</li> <li>6. Jay L. Devore, Probability and statistics for Engineering and Sciences, Thomson and Duxbburg Press, Singapore, 2002</li> <li>7. Richard A Johnson and Dean W. Wichern, Applied multivariate statistical analysis, Pearson Education, 2002</li> <li>8. Irwin Miller&amp; Marylees Miller: Mathematical Statistics :Pearson Education Inc 2004</li> <li>9. Kadiyali L R, Traffic Engineering and Trasport Planning, Khanna Publishers</li> </ol>			

### COURSE PLAN

COURSE CODE	COURSE NAME	L-T-P (C)	
08MA6201	APPLIED STATISTICS AND PROBABILITY	3-1-0 (3)	
Modules	Content	Contact Hours	Semester Exam Marks (%)
I	Probability mass functions and probability density function, distribution functions mean and variance. Binomial, Poisson, Exponential, Gamma, and Normal distribution, Mean and variance-Fitting of distributions (brief overview only)-computing probability using the above distributions.	7	15
II	Statistical Inference: Sampling distributions- Interval estimation, Confidence interval for mean, variance and regression coefficients., test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence	7	15
<b>FIRST INTERNAL EXAM</b>			
III	Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, multiple linear regression, multiple correlation co-efficient.	7	15
IV	Analysis of variance – One way designs, randomized block designs – Latin square experimental design – Factorial analysis (Introductory level).	7	15
<b>SECOND INTERNAL EXAM</b>			
V	Time Series Models: Components of time series – smoothing – measuring forecasting accuracy – testing of ARIMA models.	7	20
VI	Multivariate Analysis – Bivariate normal- Co-variance matrix- correlation matrix-bivariate normal density function – Multivariate normal (definition) - Principal components analysis (introductory level)	7	20
<b>END SEMESTER EXAM</b>			