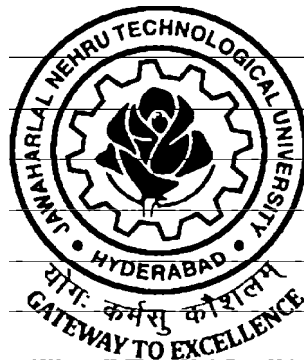


**ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS**

**M.TECH
HIGHWAY ENGINEERING**

(Applicable for the batches admitted from 2013-14)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY, HYDERABAD – 500 085.**

ACADEMIC REGULATIONS R13 FOR M. TECH. (REGULAR) DEGREE COURSE**Applicable for the students of M. Tech. (Regular) Course from the Academic Year 2013-14 and onwards**

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. TECH. DEGREE

- 2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work.
- 2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his admission, shall forfeit his seat in M. Tech. course.
- 2.3 The student shall register for all 88 credits and secure all the 88 credits.
- 2.4 The minimum instruction days in each semester are 90.

3.0 A. COURSES OF STUDY

The following specializations are offered at present for the M. Tech. course of study.

1. Advanced Manufacturing Systems
2. Aerospace Engineering/ Aeronautical Engineering
3. Automation
4. Biomedical Signal Processing and Instrumentation
5. Bio-Technology
6. CAD/CAM
7. Chemical Engineering
8. Communication Systems
9. Computer Networks
10. Computer Networks and Information Security
11. Computer Science
12. Computer Science and Engineering
13. Computers and Communication Engineering.
14. Construction Management
15. Control Engineering
16. Control Systems
17. Cyber Forensic / Cyber Security & Information Technology
18. Design for Manufacturing/ Design and Manufacturing
19. Digital Electronics and Communication Engineering.
20. Digital Electronics and Communication Systems
21. Digital Systems and Computer Electronics
22. Electrical Power Engineering
23. Electrical Power Systems
24. Electronics & Instrumentation

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25. Electronics and Communication Engineering
 26. Embedded Systems
 27. Embedded Systems and VLSI Design
 28. Energy Systems
 29. Engineering Design
 30. Environmental Engineering
 31. Geoinformatics and Surveying Technology
 32. Geotechnical Engineering.
 33. Heating Ventilation & Air Conditioning.
 34. Highway Engineering
 35. Image Processing
 36. Industrial Engineering and Management
 37. Information Technology
 38. Infrastructure Engineering
 39. Machine Design
 40. Mechatronics.
 41. Microwave & Radar Engineering
 42. Nano Technology
 43. Neural Networks
 44. Parallel Computing
 45. Power and Industrial Drives
 46. Power Electronics
 47. Power Electronics and Electrical Drives
 48. Power Engineering and Energy Systems
 49. Power Plant Engineering & Energy Management
 50. Power System Control and Automation
 51. Power System with Emphasis H.V. Engineering / H.V. Engineering
 52. Production Engineering.
 53. Real Time Systems
 54. Software Engineering
 55. Structural Engineering
 56. Systems & Signal Processing
 57. Thermal Engineering.
 58. Transportation Engineering
 59. VLSI
 60. VLSI and Embedded System/ Electronics Design Technology
 61. VLSI Design
 62. VLSI System Design
 63. Web Technologies
 64. Wireless and Mobile Communication

and any other course as approved by the University from time to time.

3.0 B. Departments offering M. Tech. Programmes with specializations are noted below:

<p>Civil Engg.</p>	<p>Construction Management Environmental Engineering Geoinformatics and Surveying Technology Geotechnical Engineering Highway Engineering Infrastructure Engineering Structural Engineering Transportation Engineering</p>
<p>EEE</p>	<p>Control Engineering Control Systems Electrical Power Engineering Electrical Power Systems Power and Industrial Drives Power Electronics Power Electronics and Electrical Drives Power Engineering and Energy Systems Power Plant Engineering & Energy Management Power System Control and Automation Power System with Emphasis H.V. Engineering / H.V. Engineering</p>
<p>ME</p>	<p>Advanced Manufacturing Systems Automation CAD/CAM Design for Manufacturing/ Design and Manufacturing Energy Systems Engineering Design Heating Ventilation & Air Conditioning Industrial Engineering and Management Machine Design Mechatronics. Power Plant Engineering & Energy Management Production Engineering Thermal Engineering.</p>
<p>ECE</p>	<p>Biomedical Signal Processing and Instrumentation Communication Systems Computers and Communication Engineering. Digital Electronics and Communication Engineering. Digital Electronics and Communication Systems Digital Systems and Computer Electronics Electronics & Instrumentation Electronics and Communication Engineering Embedded Systems Embedded Systems and VLSI Design</p>

	Microwave & Radar Engineering Systems & Signal Processing VLSI VLSI and Embedded System/ Electronics Design Technology VLSI Design VLSI System Design Wireless and Mobile Communication
CSE	Computer Networks Computer Networks and Information Security Computer Science Computer Science and Engineering Cyber Forensic / Cyber Security & Information Technology Image Processing Information Technology Neural Networks Parallel Computing Real Time Systems Software Engineering Web Technologies
Aeronautical Engg.	Aerospace Engineering / Aeronautical Engineering
Bio-technology	Bio-Technology
Chemical Engg.	Chemical Engineering
Nano Technology	Nano Technology

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered a unit.

- 4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.
- 4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.
- 4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.
- 4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class and their registration shall stand cancelled.
- 4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.
- 4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
- 4.7 A candidate shall put in a minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M. Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.
- 4.8 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the previous semester including the days of attendance in sports, games, NCC and NSS activities.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

- 5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (16 marks) which consists of four sub-questions and carries 4 marks each and Part B with 3 questions to be answered out of 5 questions each question for 8 marks. If any candidate is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the University. The details of the Question Paper pattern for End Examination (Theory) is given below:
- The End semesters Examination will be conducted for 60 marks which consists of two parts viz. i).Part-A for 20 marks, ii). Part –B for 40 marks.
 - Part-A is compulsory question where it consists of five questions one from each unit and carries four marks each. This will be treated as Question 1.
 - Part-B consists of five Questions (numbered from 2 to 6) carries 8 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice (that means there will be two questions from each unit and the student should answer only one question)
- 5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks.
- 5.3 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 5.4 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.
- 5.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.5) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and so has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled.
- 5.7 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the End Examination in that subject. He shall re-register the subject when next

offered.

- 5.8 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be another Laboratory Teacher.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

- 6.1 A Project Review Committee (PRC) shall be constituted with Principal as Chairperson, Heads of all the Departments offering the M. Tech. programs and two other senior faculty members.

- 6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

- 6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for approval. Only after obtaining the approval of the Departmental Academic Committee can the student initiate the Project work.

- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Departmental Academic Committee. However, the Departmental Academic Committee shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

- 6.5 A candidate shall submit his status report in a bound-form in two stages at least with a gap of 3 months between them.

- 6.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal through Head of the Department and make an oral presentation before the PRC.

- 6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

- 6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

- 6.9 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.

- 6.10 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

- A. Excellent
- B. Good
- C. Satisfactory
- D. Unsatisfactory

The Head of the Department shall coordinate and make arrangements for the conduct of Viva- Voce examination.

If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva- Voce examination, he will not be eligible for the award of the degree.

7.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured
First Class with Distinction	70% and above
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%
Pass Class	Below 50% but not less than 40%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

- 9.1 Discontinued, detained, or failed candidates are eligible for admission to two earlier or equivalent subjects at a time as and when offered.
- 9.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R13 academic regulations.

10. GENERAL

- 10.1 Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
- 10.2 The academic regulation should be read as a whole for the purpose of any interpretation.
- 10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

MALPRACTICES RULES**DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS**

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
 - (i) A show cause notice shall be issued to the college.
 - (ii) Impose a suitable fine on the college.
 - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

**M.TECH - HIGHWAY ENGINEERING
COURSE STRUCTURE AND SYLLABUS**

I Year I Semester

Code	Group	Subject	L	P	Credits
		Highway Infrastructure Design	3	-	3
		Urban Transportation Planning	3	-	3
		Traffic Engineering	3	-	3
		Pavement Material Characterization	3	-	3
	Elective -I	Applied Statistics Project Management Bridge Engineering	3	-	3
	Elective -II	Remote Sensing & Global Positioning Systems Engineering of Ground Concrete Technology	3	-	3
	Lab	Highway Engineering Lab - I	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

I Year II Semester

Code	Group	Subject	L	P	Credits
		Highway Project Formulation and Economics	3	-	3
		Pavement Construction, Maintenance & Management	3	-	3
		Pavement Analysis and Design	3	-	3
		Traffic Analysis	3	-	3
	Elective -III	Road Safety Engineering Land use and Transportation Modeling Transportation System Management	3	-	3
	Elective -IV	Environmental Impact Assessment for Transportation Projects GIS Applications in Transportation Engineering Optimization Techniques	3	-	3
	Lab	Highway Engineering Lab - II	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	-	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

HIGHWAY INFRASTRUCTURE DESIGN

UNIT-I:

Highway Cross Section Elements and Geometric Design Of Highways: Functional Classification of Highway System; Design Controls – Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed. Objectives of Geometric Design. Carriageway, Shoulders, Formation, Right of way; Kerbs, foot paths, Medians- design specifications; Pavement Surface characteristics – Skid Resistance, factors affecting Skid resistance, Measurement of Skid Resistance; Road Roughness, measurement of Road roughness; Camber, Objectives of Camber, design standards.

UNIT-II:

Horizontal and Vertical Alignment: Objectives of horizontal curves; Super elevation – Need for Super elevation; Method of computing super elevation; Minimum Radius of Curve; Methods of attainment of super elevation; Extra widening on Curves; Transition Curves – Objectives and Design. Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Combination of Vertical and Horizontal Curves – Grade Compensation; Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance; Importance of Sight Distances for Horizontal and Vertical Curves.

UNIT-III:

Intersection Design: Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelisation, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept and Design, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.

UNIT-IV:

Traffic Signs and Road Markings : Types of Road Signs; Guidelines for the provision of Road Signs; Cautionary Signs, Regulatory Signs, Information Signs – Design standards; Road markings – Objectives of Road Markings; Types of Road Markings; Role of Road markings in Road Safety and Traffic Regulation; Specification for Road Markings. Highway Appurtenances – Delineators, Traffic Impact Attenuators, Safety Barriers.

UNIT-V:

Miscellaneous Elements: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design.

REFERENCES:

1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna Publications.
2. Traffic Engineering and Transportation Planning, L.R.Kadiyali, Khanna Publications.
3. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
4. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

URBAN TRANSPORTATION PLANNING

UNIT-I:

Urban Transportation Problem Travel Demand: Urban Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems approach. Travel Demand: Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

UNIT-II:

Data Collection And Inventories: Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

UNIT-III:

Trip Generation and Distribution : UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates. Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models. By- pass Trips.

UNIT-IV:

Mode Choice and Traffic Assignment: Mode Choice Behaviour, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches. Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Diversion Curves.

UNIT-V:

Plan Preparation And Evaluation: Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities. Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis, Economic Impacts of Transportation.

REFERENCES:

1. Introduction to Transportation Planning – M.J.Bruton; Hutchinson of London Ltd.
2. Introduction to Urban System Planning - B.G.Hutchinson; Mc Graw Hill.
3. Traffic Engineering and Transport Planning - Kadiyali L.R., Khanna Publishers.
4. Lecture notes on UTP - Prof. S. Raghavachari , R.E.C.Warangal.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

TRAFFIC ENGINEERING

UNIT-I:**Traffic Characteristics Measurement And Analysis:**

Basic traffic Characteristics - Speed, Volume and Concentration. Relationship between Flow, Speed and Concentration. Traffic Measurement and Analysis - Volume Studies - Objectives, Methods; Speed studies – Objectives, Definition of Spot Speed, time mean speed and space mean speed; Methods of conducting speed studies; Presentation of speed study data; Head ways and Gaps; Critical Gap; Gap acceptance studies.

UNIT-II:**Highway Capacity And Level Of Service:**

Basic definitions related to capacity; Level of service concept; Factors affecting capacity and level of service; Computation of capacity and level of service for two lane highways, Multilane highways and free ways.

UNIT-III:**Parking Analysis And Traffic Safety :**

Types of parking facilities – On-street parking and Off-street Parking facilities; Parking studies and analysis- Parking Inventory Study, Parking Usage Study By Patrolling, Questionnaire Survey, Cordon Surveys; Evaluation of parking parameters; Parking accumulation, Parking Load, Parking Turnover, Parking Index, Parking Volume. Traffic Safety -Accident studies and analysis; Causes of accidents - The Road, The vehicle, The road user and the Environment; Engineering, Enforcement and Education measures for the prevention of accidents.

UNIT-IV:**Traffic Control, Regulation Signal Coordination:**

Traffic Signals –Types of Signals; Principles of Phasing; Timing Diagram; Design of Isolated Traffic Signal by Webster method, Warrants for signalization. Signal Coordination - Signal Co-ordination methods, Simultaneous, Alternate, Simple progression and Flexible progression Systems.

UNIT-V:**Traffic and Environment:**

Detrimental effects of Traffic on Environment, Air pollution; Noise Pollution; Measures to curtail environmental degradation due to traffic. Sustainable Transportation: Sustainable modes, Transit Oriented Development, ITS based benefits for Environment.

REFERENCES:

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers.
2. Traffic Engineering - Theory & Practice - Louis J.Pignataro, Prentice Hall Publication.
3. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter Kilareski, John Wiley & Sons Publication.
4. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication.
5. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
6. I.T.E. Traffic Engineering Hand Book.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

PAVEMENT MATERIAL CHARACTERIZATION

UNIT-I:

Subgrade Soil Characterization: Properties of subgrade layers; different types of soils, Mechanical response of soil; Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. SPT, DCPT, CPT, CBR, Plate Load test & resilient modulus; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Dynamic properties of soil: FWD test.

UNIT-II:

Introduction To Soil Stabilization : Physical and Chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control. Introduction to Ground improvement techniques; Introduction to Geo textiles and synthetics applications.

UNIT-III:

Aggregate Characterization: Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation, **Fuller and Thompson's Equation, 0.45 power maximum density graph; Use of locally available materials in lieu of aggregates.**

UNIT-IV:

Bitumen And Bituminous Concrete Mix Characterization: Bitumen sources and manufacturing, Chemistry of bitumen, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, stiffness modulus of bitumen mixes using shell nomographs; Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties. Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Introduction to emulsified bitumen and its characterization; Long term and short term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV.

Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Introduction to super pave mix design procedure

UNIT-V:

Cement And Cement Concrete Mix Characterization: Types of cements and basic cement properties, Special cements; Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties; Introduction to advanced concretes like self compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; IS method of cement concrete mix design with case studies; Role of different admixtures in cement concrete performance; Joint fillers for Jointed Plain Cement Concrete Pavements and their characterization

Reference Books:

1. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.
2. Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.
3. Relevant IRC and IS Codes of Practices (Separate List will be given).
4. Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003.
5. Relevant IRC and IS codes.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

**APPLIED STATISTICS
(ELECTIVE - I)****UNIT-I:**

Introduction & Sampling Techniques: Frequency distribution; Mean; Standard deviation; Standard error, Skewness; Kurtosis; Definitions and Applications; Simple random sampling; Stratified sampling; Systematic sampling; Sample Size determination; Applications in Traffic Engineering,

UNIT-II:

Statistical Distributions and Probability : Binomial, Poisson, Exponential and Normal distributions; Fitting of distributions; Mean and variance; Chi-square test of goodness-of-fit; Applications in Traffic Engineering. Probability - Laws of Probability; Conditional probability and Independent events; Laws of expectation.

UNIT-III:

Regression And Correlation: Linear regression and correlation; Multiple correlation; Multiple correlation coefficient; Standard error of estimate; Analysis of Variance; Curvilinear regression; Applications in Transportation Engineering.

UNIT-IV:

Multi Variate Data Analysis and Exact Sampling Distributions : Types of data; Basic vectors and matrices; Simple estimate of centroid, Standard deviation, Dispersion, Variance and covariance; Correlation matrices; Principal component analysis; Time series analysis. Exact Sampling Distributions - Chi-square distribution; Students T-distribution; Snedectors F-distribution.

UNIT-V:

Tests Of Significance & Confidence Interval – I & II: Large sample and small sample tests; Tests for single mean, Means of two samples, Proportions, two variances, two observed correlation coefficients, paired T-tests, Applications. Tests Of Significance & Confidence Interval – II -Intervals for mean, variance and regression coefficients; Applications in Traffic Engineering problems.

REFERENCES:

1. Basic Statistics - Simpson and Kafks; Oxford and IBH Calcutta, 1969.
2. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K.V.Sultanchand.
3. Multivariate Data Analysis –Cootey W.W & Cohens P.R.;John Wiley & Sons.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

PROJECT MANAGEMENT

ELECTIVE - I

UNIT-I:

Introduction to Project Management: A systems Approach, Systems Theory and Concepts, Organisation, Management Functions, Overview of Management Objectives, Tools and Techniques, Project Management – Processes and Organisational Structures – Team Management – Project Manager as a Team Leader – Leadership Qualities, PMIS

UNIT-II:

Construction Cost and Value Engineering: Types of Estimates, Implementation of Cost Controls, Project Cost Forecasting, Cost Optimisation and Resources Planning - Value Engineering, Techniques for Project Selection, Break-Even Analysis, Cost Modelling, Energy Modelling, Life Cycle Cost Approach.

UNIT-III:

Contract Management Safety in Construction Industry : Tendering and Contracting, Laws of Contracts, subcontracts, Potential Problems, Post Contract Problems, Documents, Conditions, Arbitration, Special Features of International Contracts. Quality Management and Safety in Construction Industry - Quality control by statistical methods, sampling plan, control charts, ISO 14000, Safety Measures, Safety Programmes, Safety Awareness and Implementation of Safety Plan – Compensation.

UNIT-IV:

Project Scheduling and Analysis Methods : CPM, PERT, Linear programming, queuing concept, simulation, bidding models, game theory.

UNIT-V:

Human Resource Management and Construction Management Practices : Man Power Planning – Training – Motivation – Industrial Relations – Welfare Measures – MIS – Components and Structure – Personal Management. Resource Management and Inventory - Basic concepts, labour requirements & productivity, non-productive activities, site productivity, equipment and material management, inventory control. Construction Management Practices - Implementation of Procedures and Practices – International Experiences – Case Studies – Examples.

REFERENCES:

1. Herold Kerzner - Project Management - A systems approach to Planning, Scheduling and Controlling. CBS Publishers and Distributors.
2. K.Waker A Teraih and Jose M.Grevarn; Fundamentals of Construction Management and Organisations.
3. Anghel Patterson - Construction Cost Engineering Handbook - Marcel Dekken Inc.
4. Dell Isola - Value Engineering in Construction Industry, Van Nostrand Reinhold Co.,
5. Choudhary, S. Project Management, Tata McGraw Hill Publishing Co., Ltd.,
6. Raina UK, Construction management Practices, Tata Mc Grawhill Publishing Company Ltd.
7. Sengupta B and Guha H, Construction Management and Planning, Tata McGraw-Hill Publishing Company Limited, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

BRIDGE ENGINEERING

(ELECTIVE - I)

UNIT-I:

Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Sesmic loads- Frictioal resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of raodway and footway-General Design Requirements.

UNIT-II:

Solid slab, Girder Bridges & Continuous Bridges: Introduction-Method of Design. Girder Bridges - Introduction-Method of Design-Courbon's Theory. Continuous Bridges - Introduction- Span lengths- Analysis of Continuous bridges-Decking of Girders with constant Moment of Inertia-Continuous bridges with variable Moment of Inertia-Method of Analysis -Girders with Parabolic Soffit-Method of plotting Influence lines-Girders with Straight Haunches-Design steps for Continuous Bridges.

UNIT-III:

Pre-Stressed Concrete Bridges: Basic principals- Method of Pre-srtessing-Pretensioning and Post-tensioning- Comparision-Freyssinet Method-Magnel-Bl Janet System-Lee-Mc call system-Basic Assumptions-Losses in Prestress-Equation based on Initial and final stress conditions-Cable Zone- Design of selections-Condition of first crack- Ultimate load design-Shear-Vertical Prestressing-Diagonal Tension in I-section-End Block-Magnel's method-Emperical Method-General Design requirements-Mild steel reinforcement in prestressed concrete member-Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section-Propped-Design of Propped Composite Section-Unpropped composite section-Two-stage Prestressing-Shrinking stresses-General Design requirements for Road Bridges.

UNIT-IV:

Analysis of Bridge Decks: Harmonic analysis and folded plate theory-Grillage analogy- Finite strip method and FEM.

UNIT-V:

Sub-structure of bridges: Substructure- Beds block-Piers- Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

REFERENCES:

1. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani.
2. Bridge Deck Behaviour by E.C.Hambly.
3. Concrete Bridge Design and Practice by V.K.Raina.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

**REMOTE SENSING & GLOBAL POSITIONING SYSTEMS
(ELECTIVE – II)****UNIT-I:**

Remote Sensing Technology : Basic Principles – Introduction , Electromagnetic and its properties, interaction with Earth surface materials, recent developments in Remote sensing, Social and legal implications of Remote Sensing, status of Remote Sensing. - Remote Sensing Platforms & Sensors - Introduction, Characteristics of imaging remote sensing instruments, satellite remote sensing system – a brief over view , other remote sensing satellites.

UNIT-II:

Pre-Processing and Enhancement Techniques for Remotely Sensed Data: Introduction, cosmetic operation; Geometric connection and registration, atmospheric correction. Enhancement Technique - Introduction, human visual system, contrast enhancement; Pseudo color enhancement.

UNIT-III:

Image Transforms: Introduction, arithmetic operations, empirically based image transforms, Principal component analysis , Multiple discriminant analysis etc.

UNIT-IV:

Filtering Technique Classification: Low-pass (smoothing filters) High pass (sharpening) filters, edge detection, frequency domain filters, geometrical basis, classification, Unsupervised and supervised classification, classification accuracy.

UNIT-V:

G.P.S.: Introduction, Elements of satellite surveying, e global positioning system, GPS satellites, Adjustment computations, GPS observables, Application of GPS technology in Highway alignment, Network planning.

REFERENCES:

1. GPS Satellite Surveys, Alfred Leick , Willey & Sons.
2. Principles of Remote Sensing , Paul Jumani, ELBS, 1985.
3. Computer Processing of Remotely sensed Images An Introduction – Paul M.Mather, John Wiley & Sons 1989.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

**ENGINEERING OF GROUND
(ELECTIVE – II)****UNIT-I:**

Introduction to Engineering Ground Modification: Need and objectives, Identification of soil types, In situ and laboratory tests to characterise problematic soils; Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods, and their applications.

UNIT-II:

Mechanical Modification – Deep Compaction Techniques- Blasting Vibrocompaction, Dynamic Tamping and Compaction piles.

UNIT-III:

Hydraulic Modification – Objectives and techniques, traditional dewatering methods and their choice, Design of dewatering system, Electro-osmosis, Electro-kinetic dewatering.

Filtration, Drainage and Seepage control with Geosynthetics, Preloading and vertical drains,

UNIT-IV:

Physical and Chemical Modification – Modification by admixtures, Shotcreting and Guniting Technology, Modification at depth by grouting, Crack Grouting and compaction grouting, Jet grouting, Thermal Modification, Ground freezing.

UNIT-V:

Modification by Inclusions and Confinement - Soil reinforcement, reinforcement with strip, and grid reinforced soil. In-situ ground reinforcement, ground anchors, rock bolting and soil nailing.

Text Books

1. Hausmann, M. R. (1990) – Engineering Principles of Ground Modifications, McGraw Hill publications.
2. M. P. Moseley and K. Krisch (2006) – Ground Improvement, II Edition, Taylor and Francis.

References:

1. Koerner, R. M (1994) – Designing with Geosynthetics – Prentice Hall, New Jersey.
2. Jones C. J. F. P. (1985) – Earth Reinforcement and soil structures – Butterworths, London.
3. Xianthakos, Abreimson and Bruce - Ground Control and Improvement.
4. K. Krisch & F. Krisch (2010) - Ground Improvement by Deep Vibratory Methods, Spon Press, Taylor and Francis.
5. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

**CONCRETE TECHNOLOGY
(ELECTIVE II)****UNIT-I:**

Cement and Admixtures : Portland cement - chemical composition – Bogue's compounds - hydration - structure of hydrated cement - mechanical strength of cement gel - water held in hydrated cement paste - heat of hydration of cement - influence of compound composition on properties of cement - different types of cements. Admixtures - Classification – Mineral and chemical admixtures - Classification of mineral admixtures – properties – dosage - uses – Chemical admixtures – classification – properties – uses – High range water reducing agents – effect of dosage – multiple dosage of admixtures and their effects – effects of admixtures in RMC.

UNIT-II:

Aggregates: Classifications of aggregates - particle shape and texture - bond, strength and other mechanical properties of aggregate - specific gravity, bulk density, porosity, absorption and moisture content of aggregate - bulking of sand - deleterious substance in aggregate - soundness of aggregate - alkali-aggregate reaction - thermal properties - sieve analysis - fineness modulus - grading curves - grading of fine and coarse aggregates - gap graded aggregate - maximum aggregate size – combined a grading – BIS grading.

UNIT-III:

Fresh Concrete and Hardened Concrete: workability - factors affecting workability - measurement of workability by different tests - effect of time and temperature on workability - segregation and bleeding - Mixing of concrete - different types of mixing – vibration of concrete – re-vibration – setting times of fresh concrete – steps in manufacture of concrete – quality of mixing water. Hardened Concrete - water/cement ratio - Abram's law – Gel space ratio Maturity concept - effective water in mix - nature of strength of concrete - strength in tension and compression - Griffith's hypothesis - autogenous healing - curing of concrete - influence of temperature on strength - steam curing - testing of hardened concrete – relation between compressive and tensile strength - factors affecting strength - non-destructive testing methods. Durability of concrete - code provisions.

UNIT-IV:

Elasticity, Shrinkage and Creep: Modulus of elasticity – static and dynamic modulus of elasticity - Poisson's ratio - early volume changes - swelling - shrinkage - mechanism of shrinkage - factors affecting shrinkage - differential shrinkage - moisture movement - creep of concrete - factors influencing creep - relation between creep and time - nature of creep - effects of creep in structural concrete – Code provisions – Rheology of creep.

UNIT-V:

Concrete Mix Design and Special Concrete Issues : factors in the choice of concrete mix proportions – statistical quality control – Acceptance criteria as per IS 456-2000 – various mix design methods for normal concrete – BIS method – Road note no.4 method, ACI method – High strength concrete mix design – durability aspects in concrete mix design as per IS 456-2000. Special Concrete - Light weight concrete – Light weight aggregates – Light weight concrete mix design – Cellular concrete – Fiber reinforced concrete – Different types of fibres – Factors affecting properties of F.R.C. – Applications – Polymer concrete – Types of polymer concrete – Properties of polymer concrete – Applications – High Performance Concrete -Self Compacting concrete – smart concrete.

TEXT BOOKS:

1. Properties of Concrete by A.M.Neville, ELBS publications.
2. Concrete Technology by M.S.Shetty, S.Chand & Co.

REFERENCES:

1. Special Structural concretes by Rajat Siddique, Galgotia Publications.
2. Design of Concrete Mixes by N.Krishna Raju, CBS Publications. Concrete: Micro Structure by P.K.Mehta, ICI, Chennai.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (Highway. Engg.)

HIGHWAY ENGINEERING LAB – I.

1. Test on soil –

- i) Soil Consistency test, Sieve Analysis
- ii) CBR test
- iii) Compaction of Soil
- iv) Standard Proctor test

2. Test on Aggregate –

- i) Shape test
- ii) Impact and crushing tests on aggregate
- iii) Abrasion and Attrition test
- iv) Soundness test

3. Tests on Bitumens –

- i) Viscosity, Penetration, Ductility tests
- ii) Flash and fire point tests
- iii) Rolling thin film test, Bitumen extraction tests

4. Test on Bitumen & Concrete mix –

- i) Design of Cement Concrete Mix for Highway
- ii) Marshal Stability Mix Design

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

HIGHWAY PROJECT FORMULATION & ECONOMICS

Unit I:

Project Formulation: Requirements in project formulation, Criteria fixation, Components of project, Non-monetary and monetary Criteria in formulation of project, Decision making Criteria input in Project formulation. Preparation of DPR - Guidelines

Unit II:

Transport Projects Formulation and Economic Evaluation of Transportation Plans : - development of cash flow diagrams, Cost and benefit components, Discounting criteria, Preparation of Project, Highway Planning, Traffic infrastructure, Project formulation, Road Network project development - Economic evaluation of Transportation plans; Need for Economic Evaluation; Principles of economic evaluation; Welfare economics; Social costs, Vest change, Rate of return.

Unit III:

Value of Travel time Savings and Accident Costs : Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs; Components of VOC, Road User Cost study in India.- Accident costs; Methodologies for economic evaluation of an accident; Factors involved.

Unit IV:

Basic methods of economic analysis and Project Appraisal : Equivalent Uniform Annual Cost Method; Present worth of cost method; Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method. Applications of these methods to highway projects. - Project appraisal by shadow pricing with case studies.

Unit V:

Environmental impact assessment: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety and Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies.

REFERENCES:

1. Transportation Engineering Economics - Heggie. I. G.; Mc Graw Hill Publishers.
2. Economic Analysis for Highways - Winfrey.R; International TextBook Company.
3. Traffic Engineering and Transport Planning - L.R Kadiyali, Khanna Publishers.
4. Road User Cost Study, CRRI.
5. Road Project Appraisal, for Developing Countries, J.W.Dickey ,John Wiley & Sons.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT

Unit I

Pavement Management System: Components of PMS and their activities; Major steps in implementing PMS; Pavement Maintenance Management Components of Maintenance Management and Related Activities – Network and Project Level Analysis; Prioritization Techniques and Formulation of Maintenance Strategies

Unit II

Pavement Inventories and Evaluation : Serviceability Concepts ;Visual Rating ;Pavement Serviceability Index; Roughness Measurements ;Distress Modes – Cracking Rutting Etc; Pavement Deflection – Different Methods, Skid Resistance, Roughness, Safety – Aspects; Inventory System – Assessment of Deficiencies

Unit III

Pavement Maintenance and Quality Control : Causes of Deterioration, Traffic and Environmental Factors, Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance; Quality Control – ISO 9000 , Sampling Techniques – Tolerances and Controls related to Profile and Compaction

Unit IV

Construction of Base, Subbase, Shoulders and Drain : Roadway and Drain Excavation, Excavation and Blasting, Embankment Construction, Construction of Gravel Base, Cement Stabilised Sub- Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Shoulder Construction; Drainage Surface, Turfing Sand Drains; Sand Wicks; Rope Drains, Geo- Textile Drainage; Preloading Techniques

Unit V

Bituminous Pavement Construction and Cement Concrete Pavement Construction: Preparation and Laying of Tack Coat; Bituminous Macadam ,Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments and Overlay Construction, IRC Specifications, Introducing Mechanical Mixers, Pavers, Finishers ; Cement Concrete Pavement Analysis - Construction of Cement Roads, Manual and Mechanical Methods, Joints in Concrete and Reinforced Concrete Pavement and Overlay Construction –Related Equipment

References:

1. Haas and Hudson , W. R. Pavement management systems –McGraw Hill publications.
2. Sargious, M. A. – Pavements and surfacing for highways and airports – Applied Science Publishers Ltd.
3. Bridge and Pavement maintenance- Transportation Research Record no.800, TRB.
4. Shahin M.Y, 1994- Pavement management for airports, roads and parking lots.
5. Bent Thagesan, 1996- Highway and Traffic engineering for developing countries.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

PAVEMENT ANALYSIS AND DESIGN

Unit I

Factors Affecting Pavement Design: Variables Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.

Unit II

Stresses In flexible and Rigid Pavements: Stress Inducing Factors in Flexible and Rigid pavements; Stress In Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts; Stresses In Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, Stresses in Dowel Bars & Tie Bars

Unit III

Material Characteristics: CBR and Modulus of Subgrade Reaction of Soil, Mineral aggregates – Blending of aggregates, binders, polymer and rubber modified bitumen, Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties, Effects and Methods of Stabilisation and Use of Geo Synthetics. Non destructing testing

Unit IV

Design Of Flexible and Rigid Pavements: Development of design methods, Flexible Pavement Design Concepts, Asphalt Institute's Methods with HMA and other Base Combinations, AASHTO, IRC Methods for highways and low volume roads, Design Of Rigid Pavements: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Rigid Pavement Design for Low Volume Rural Roads and highways. Design Of Overlays: Types & Design of Overlays: IRC Methods of Overlay Design, Importance of Profile Correction Course.

Unit V

Runway Design : Aircraft configurations, Flexible airport pavements - IS specifications and design, Corps of Engineers, FAA methods, AI methods ; Rigid airport pavements – IS specifications, PCA method, Corps of Engineers method, FAA method.

References:

1. Design of Functional Pavements, Nai C. Yang, McGraw Hill Publications.
2. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers.
3. Principles of Pavement Design, Yoder.J. & Witzorac Mathew, W. John Wiley & Sons Inc.
4. Pavement Analysis & Design, Yang H. Huang, Prentice Hall Inc.
5. Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
6. IRC Codes for Flexible and Rigid Pavements design.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

TRAFFIC ANALYSIS

UNIT-I:

Traffic Flow Description: Types of Statistical distributions; Discrete and continuous distributions; Counting and Interval Distributions used in Traffic Analysis; Poisson's distribution for vehicle arrivals; Headway Distributions – Exponential Distribution; shifted Exponential distribution; Erlang Distribution; composite Distribution.

UNIT-II:

Queueing Theory: M/M/1 & D/D/1 System: Introduction to queueing Theory; notation used for describing a queue system; Analysis of M/M/1 system; Assumptions and Derivation of System State Equations; Application of M/M/1 analysis for parking Garages and Toll Plazas- numerical Examples. Queueing Theory - D/D/1 System: Traffic Interruptions like Accidents or Bottlenecks; Analysis of D/D/1 system for delay characteristics; Traffic Signal analysis as D/D/1 system; Computation of delays and queue dissipation Time – Numerical Examples.

UNIT-III:

Pedestrian Delays And Gaps: Pedestrian Gap acceptance and delays; Concept of Blocks, Anti-blocks, Gaps and Non-Gaps; Underwood's analysis for Pedestrian Delays; Warrants for Pedestrian Crossing Facilities – Minimum Vehicular Volume Warrant, Minimum Pedestrian Volume Warrant, Maximum Pedestrian Volume Warrant;

UNIT-IV:

Shockwave Theory: Concept of Shockwave; causes for Traffic Interruptions and Shockwaves; Flow-Density diagram use in Shockwave analysis; Use of Time-space diagram for shockwave description; Bottleneck situations and shockwaves; traffic signal and shockwave theory; numerical Examples for application of shockwave theory;

UNIT-V:

Traffic Simulation: Introduction to Simulation; Need for Simulation Modelling; Steps in Simulation; Interval Oriented and Event Oriented Simulation; Use of Random Numbers in Simulation; Random Number generation methods; Computing headways and arrival times based on random numbers; Basic concepts of simulation modelling application for Signalised Intersections, Pedestrian Crossings and Transit scheduling.

REFERENCES:

1. Traffic Flow Theory: A Monograph , TRB Special Report 165.
2. Fundamentals of Transportation Engineering – C.S.Papacostas, Prentice Hall India Publication.
3. Principles of Highway Engineering and Traffic Analysis – F.L.Mannering & W.P.Kilareski, John Wiley Publishers.
4. Traffic Flow Fundamentals – A.D.May, , Prentice Hall India Publication.
5. Fundamentals of Traffic Engineering – McShane & Rogers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

ROAD SAFETY ENGINEERING
(ELECTIVE III)**Unit I:**

Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Traffic Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

Unit II:

Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction

Unit III:

Road Safety in Planning And Geometric Design: Vehicle And Human Characteristics, Road Design and Road Equipments, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care

Unit IV:

Role of Urban infrastructure design in safety: Geometric Design of Roads; Design of Horizontal and Vertical Elements, Junctions, At Grade and Grade Separated Intersections ,Road Safety in Urban Transport, Sustainable Modes and their Safety.

Unit V:

Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

References:

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers.
2. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. Transportation Engineering – An Introduction, C.Jotin khisty, B. Kent Lall.
4. Fundamentals of Traffic Engineering, Richardo G Sigua.
5. Handbook of Road Safety measures, second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson.
6. Road Safety by NCHRP.

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M. Tech – I Year – II Sem. (Highway. Engg.)

**LAND USE AND TRANSPORTATION MODELLING
(ELECTIVE III)****UNIT-I:**

Land Use And Transportation Engineering: Transportation modeling in Planning; Models and their role, Characteristics of Transport demand and supply, Equilibrium of supply and demand, Modeling and decision making, Issues in Transportation modeling and structure of the classic transport model.

UNIT-II:

Land Use Transportation Models: Introduction to Land Use Planning; Relation between Transportation and Land Use Planning; The economic base mechanism and allocation mechanism; Spatial allocation and employment interrelationship; Garin Lowry models.

UNIT-III:

General Travel Demand Models: Aggregate, Disaggregate models ; Behavioral models; Recursive and direct demand Models; Linear, Non-Linear models; Logit, discriminant and probit models; Mode split models - Abstract mode and mode specific models.

UNIT-IV:

Regional Transport Models: Factors affecting goods and passenger traffic; Prediction of traffic; Growth factor models; Time function iteration models; Internal volume forecasting models.

UNIT-V:

Regional Network Planning: Problems in Developing Countries, Network Characteristics - Circuitry, Connectivity, Mobility, Accessibility and Level of Service Concepts - Network Structures and Indices – Network Planning – Evaluation - Graph Theory – Cut sets – Flows & Traversing – Optimum Network - Inter-modal Co-ordination. – Rural Road Network Planning.

REFERENCES

1. Modelling Transport by Jhan De Dios Ortuzar. Luis E. Willumsen. John Wiley & Sons. 1970/1975.
2. Urban Development Models - Ed. By R. Baxter, M. Echenique and J. Owers; The Institute of Transportation Engineering, University of California.
3. Economic Models and Economic Forecast - Robert S. Pindyck, Daniel L. Rubinfeld; McGraw Hill.
4. Land Use Transportation Planning Notes - S.R. Chari, REC Warangal.
5. Regional and Urban Models- A.G. Wilson; Pion, London.
6. Urban Modeling - Michael Batty.
7. Behavioral Travel Demand Models - Peter R. Stopher ARNIM.H.MEYBURG.
8. Introduction to Transportation Engineering and Planning, Morlok EK, McGraw Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (Highway. Engg.)

TRANSPORTATION SYSTEMS AND MANAGEMENT
(ELECTIVE III)**UNIT-I:**

TSM Philosophy: Systems approach to Transportation Planning; Long Term Strategies and Short term Measures; TSM actions – Objectives and Philosophy; Relevance of TSM actions to Indian Urban Context. Broad spectrum of TSM actions.

UNIT-II:

Traffic Management Measures: Measures for Improving Vehicular Flow – One Way Streets, Signal Improvements, Transit Stop Relocation, Parking management, Reversible lanes; Reducing Peak Period Traffic – Staggering of Working hours, Congestion Pricing, differential Toll Policies.

UNIT-II:

Measures To Promote Transit and Non-Auto Modes: Preferential Treatment to High Occupancy Vehicles; Car Pooling; Transit Service Improvement Measures; Transit management Improvement Measures; Transit and Para Transit Integration; Para-transit Role in Urban Areas; Multi-modal coordination. Measures to Promote Non-Auto modes - Pedestrianisation; Bicycle Transportation – Advantages; planning Bicycle facilities – Class I, Class II and Class III Bikeways; Junction Treatments for Cycle Tracks; LOS criteria for Pedestrian and Bicycle facilities.

UNIT-IV:

Bus Route Network Planning And Management: Types of Bus Route Net works; Suitability for a given Urban Area; Types of Routes – Corridor Routes, Activity Routes and Residential Routes; Issues in Route Network Evaluation – Number of Routes, Length of Routes; Route Alignment Methods; Service Coverage and Accessibility Index.

UNIT-V:

Advanced Transit Technologies: Conventional and Unconventional Systems; Rapid Transportation Systems; New Technologies – LRT, Monorail, Automated Highways, Hovercraft; System characteristics and suitability.

REFERENCES:

1. Transportation System Management Notes, S.R.Chari, REC, Warangal.
2. Metropolitan Transportation Planning, John W Dickey, Tata McGraw Hill.
3. The Bicycle Planning, Mike Hudson, Open Books, UK.

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M. Tech – I Year – II Sem. (Highway. Engg.)

**ENVIRONMENTAL IMPACT ASSESSMENT FOR TRANSPORTATION PROJECTS
(ELECTIVE IV)****UNIT-I:**

Introduction: Environment and its interaction with human activities - Environmental imbalances - Attributes, Impacts, Indicators and Measurements - Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

UNIT-II:

Environmental Indicators - Indicators for climate - Indicators for terrestrial subsystems - Indicators for aquatic subsystems - Selection of indicators - Socio-economic indicators - Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

UNIT-III:

Environmental Impact Assessment For Transportation Projects: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety & Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies

UNIT-IV:

Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Green house effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development

UNIT-V:

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies Adhoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing A Methodology, Review Criteria.

REFERENCES:

1. Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York.
2. Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York.
3. UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris.
4. Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York.

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GIS APPLICATIONS IN TRANSPORTATION ENGINEERING

(Elective – IV)

UNIT-I:

Introduction to GIS and Data Input & Output: Introduction, GIS over view, use of GIS in decision making, Data processing, Components of GIS, The GIS and the organization. Data Input and Output - Data input - Key board entry, Manual digitizing, Scanning, Remotely and sensed data, existing digital data, census related data sets, Data output - Hard copy and soft, copy devices.

UNIT-II:

Data Quality and Management : Components of data quality - Micro level, Macro level components, Sources of error, A note about data accuracy. Data Management - The data base approach, 3 classic data models, Nature of geographic data, Spatial data models, Databases for GIS.

UNIT-III:

GIS Analysis and Functions: Organizing geographic data for analysis, Maintenance and analysis of the spatial data and non-spatial attribute data and its integration output formatting.

UNIT-IV:

Implementing a GIS: Awareness, Developing system requirements, Evaluation of alternative systems, System justification and Development of an implementation plan, System acquisition and start up, Operation of the system.

UNIT-V:

Application of GIS in Transportation Engineering – I & II : Intelligent information system for road accessibility study, GIS data base design for physical facility planning, Decision support systems for land use planning. Application of GIS in Transportation Engineering – II - GIS applications in environment impact assessment, GIS based Highway alignment, GIS based road network planning, GIS based traffic congestion analysis and accident investigation.

REFERENCES:

1. GIS for Urban & Regional Planning, Scholten & Stillwen 1990, Kulwer Academie Publisher.
2. GIS A Management, Perspenfi Stan Aronoff, WDL Publisher.
3. GIS By Stonffer.

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M. Tech – I Year – II Sem. (Highway. Engg.)

OPTIMIZATION TECHNIQUES

(Elective – IV)

Unit I

Linear Programming: Introduction and formulation of models; Convexity; simplex method; Two phase method; Degeneracy, non - existent and unbounded solutions; Duality in L.P. Dual simplex method, Sensitivity analysis; Revised simplex method; transportation and assignment problems.

Unit II

Non-Linear Programming: Classical optimisation methods; Equality and inequality constraints; Lagrange multipliers; & Kuhn-Tucker conditions; Quadratic forms; Quadratic programming and seal's methods.

Unit III

Search Methods: One dimensional optimisation; Fibonacci search; multi dimensional search methods; Univariate search; gradient methods; steepest descent/ascent methods; Conjugate Gradient method; Fletcher - Reeves method; Penalty function approach.

Unit IV

Dynamic Programming: Principle of optimality; Recursive relations; solution of L.P.Problem; simple examples.

Unit V

Integer Linear Programming: Gomory's cutting plane method; branch and bound algorithm; traveling salesman problem; Knapsack problem; Linear C-1 problem.

References:

1. Introduction to Optimisation - J.C.Pant; Jain Brothers; New Delhi.
2. Optimisation Theory and Applications - S.S.Rao; Wiley Eastern Ltd., New Delhi.
3. Optimisation Method - K.V.Mital; Wiley Eastern Ltd.. New Delhi.

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M. Tech – I Year – II Sem. (Highway. Engg.)

HIGHWAY ENGINEERING LAB - II

1. Traffic Surveys:

- i. Traffic Volume Studies
- ii. Spot Speed Studies
- iii. Floating Car Technique
- iv. Headway and Gap-Acceptance Studies
- v. Delay Studies
- vi. Pedestrian Survey

2. Parking Surveys:

- i. On-Street Parking Studies
- ii. Off-Street Parking Studies

3. Highway Capacity Estimation

4. MX – Roads

5. Road Safety Auditing

References:

1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna, 2007.
2. Traffic Engineering and Transportation Planning, L.R.Kadiyali, Khanna Publications, 2007.