REVA UNIVERSITY
Bengaluru, India

SCHOOL OF CIVIL ENGINEERING

HANDBOOK

M. Tech. in Computer Aided Structural Engineering

2018-20

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Rukmini Educational
Charitable Trust

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MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven engineering courses after studying the requirements of industries in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills to opt for different job prospects across the global.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of ***M.Tech in Transportation Engineering and Management*** and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country.

I wish you every success in your career.

MESSAGE FROM THE VICE CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the real world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care and after detailed market survey of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

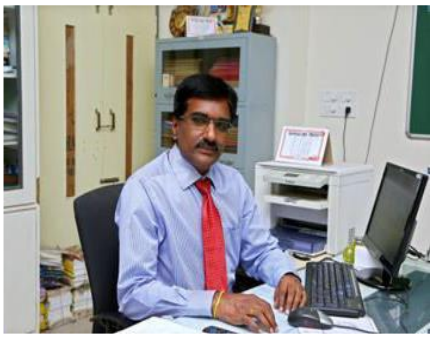
The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society. It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects. It facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the university. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing a brief information about ***M Tech in Transportation Engineering and Management***, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed and to work hard and make use of enormous resources and expert faculties to accomplish all round development of their personalities and succeed with flying colours not only in earning degree but also in their future career as leaders and proud citizens of mother India.

Dr. S.Y.Kulkarni
Vice-Chancellor, REVA University

MESSAGE FROM THE DIRECTOR



The curriculum of an institution of higher learning is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The curriculum of the B. Tech, M.Tech and other programs of REVA University is no exception.

An experience of a decade in preparing graduates and postgraduates in engineering, architecture, law, commerce and science for a wide variety of industries & research level organizations has led to creation of the new curriculum. I sincerely believe that it will meet the aspirations of all stake holders – students, faculty and the employers of the graduates and postgraduates of REVA University.

The curriculum has been designed in such a way that the teacher enjoys freedom to expand it in any direction he feels appropriate and incorporates the latest knowledge and stimulates the creative minds of the students. There is also provision for new experiments with new contents and new techniques. This is going to lead to new teaching – learning paradigm with experiential, experimental & industry relevant approaches. The present curriculum is contemporary because it is culmination of efforts of large number of faculty members, experts from industries and research level organizations. An effort of benchmarking this curriculum with curriculum of other institutions of repute like NITs and IITs has been done.

I am very sure that all students of REVA University enjoy this curriculum and take fullest advantage to expose themselves to fundamentals and applications. Also, imbibe all attributes that are required to term them as Global Engineers. The innovativeness and creativity being introduced should be explored fully by our students.

The flexibility in the curriculum permits staff and students to incorporate changes in terms of addition of new courses and deletion of irrelevant courses keeping the rapid advances in the technology into consideration.

I also record my personal gratitude to Chancellor, Vice chancellor and members of Academic Senate who have lent every bit of their wisdom to make this curriculum truly superior. The importance of transportation in the economic progress and social welfare of communities need not be over emphasized - it is well established. With globalization and the boom in infrastructure projects there is a steady demand of qualified personnel to create a good transportation network and manage the vast transportation network that is existing to meet the ever increasing travel demand.

The road construction technology has witnessed a sea change in the design, construction and maintenance aspects. However there is a gap between the theory and practice. Also, the importance of the Traffic Engineering, Transportation Planning and Sustainability have been realized only in the recent past.

M Tech in Transportation and Engineering and Management program meant for students with a bachelor's degree in Civil Engineering is intended to provide an in-depth knowledge of both the aspects of transportation systems, namely engineering and management, with emphasis on road transportation. It includes courses on Highway Materials, Ground Improvement Techniques, Pavement Analysis and Design, Pavement Evaluation and Management Systems, Geometric Design of Highways, Traffic Engineering, Road Safety, Transportation System Management, Urban Transport Planning, Rural Roads, Highway Construction and Maintenance, Highway Construction Planning and Management, Highway Economics and Project Evaluation and Sustainable Urban Transport Systems.

The benefits of choosing Transportation Engineering and Management program are:

- Flexibility to choose various fields various specializations for study.
- Opportunity to work on live problems.
- Opportunity to work on latest technologies.
- Opportunity for designers & planner to plan & design live projects.

On completion of the program, the students have wide scope for placement in Multi-National Companies specializing in Transportation Consultancy/Construction, Government Organizations such as the Public Works Department, Highways and Transportation Authorities, Planning and Development Departments, Educational Institutions. There is ample scope for Self-employment and becoming a job-giver rather than a job-seeker.

I am sure the students choosing M Tech in Transportation Engineering and Management in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. Y. Ramalinga Reddy

Director

School of Civil Engineering

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notch educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 42 acres of land equipped with state-of-the-art infrastructure and conductive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and other staff.

Currently, REVA University offers 18 Post Graduate programs and 15 Graduate and P.G Diploma programs in Engineering and Technology, Science, Commerce and Management, Architecture, Law in addition to research degrees leading to PhD in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education, etc., in the years to come.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

ABOUT SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering is headed by highly experienced Professor of Civil Engineering and is supported by well qualified faculty members. The school has the state-of-art class rooms and well equipped laboratories. It offers B.Tech in Civil Engineering and M.Tech in Computer Aided Structural Engineering and M Tech in Transportation Engineering & Management. The school also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry application oriented. The M. Tech in Computer Aided Structural Engineering program aims to prepare human resources to play a leading role in the competitive construction field and excel in their endeavors. The program focuses on research and design in the core and Computer Aided Structural Engineering. The M.Tech in Transportation Engineering & Management aims to supplement and create a sustainable world and to enhance the global quality of life by adopting enhanced techniques of design and application. This is reflected in various core subjects offered within the program. Currently Civil Engineering teaching was limited to planning, analysis, design and execution of different types of infrastructure like buildings, roads, bridges, dams and power plants. However, due to increase of technological sophistication and demand for higher living standards geared up by economic growth and concerns about environmental impact have changed the scope of Civil Engineering. The challenges of today's Civil Engineering infrastructure are much more complex and interdependencies between resources.

Even though there are a large number of institutions in the country which are producing Civil Engineers, there is acute shortage of quality Civil Engineers. The REVA University would like to offer Civil Engineering Programme to produce quality engineers who are effective and efficient in problem solving and providing economical and sustainable infrastructural solutions.

Vision

To produce young Engineers of caliber, who would be committed to their profession with ethics, will be able to contribute to Civil Engineering and allied fields in optimizing usage of resources globally making the world more eco-friendly to live in.

Mission

- *To make the Department centre of excellence for training the undergraduate students.*
- *To promote involvement of staff and students in research and advanced training.*
- *To develop good understanding skills in student communities about Civil Engineering, ethical practices, automation design and society need centric teaching and learning and imparting value addition skills.*

ACADEMIC OBJECTIVES

- To prepare graduates and post graduates in CIVIL ENGINEERING who will excel in their professional career and contribute with commitment and dedication to the progress of the society and the nation.
- To enhance the understanding of the engineering principles of Civil Engineering systems.
- Graduates will be prepared with a solid foundation in mathematics, sciences, and technical skills needed to analyze and design civil infrastructure systems.
- The professional careers of our graduates will be distinguished with a high degree of awareness of moral, ethical, legal and professional obligations to protect human health, human welfare, and the environment.
- A commitment to continue assessment in continuing education.
- Our graduates will become team leaders, and will successfully address open-ended problems applying critical thinking.
- To promote faculty, researchers and students to participate in national and international conferences, seminars, workshops etc. and present their research outputs. Also research output to publish in journals of repute, publish books in relevant fields and popular articles for the benefit of the society at large.

- To organize conferences, seminars, workshops, special lectures, summer schools, technical talks, faculty development programmes etc. on emerging areas.
- To establish incubation centre and center of excellence in thrust areas in collaboration with industries.
- To organize and promote co-curricular and extra-curricular activities that inculcate among students concerned to the society.

ADVISORY BOARD

Sl. No.	Name of Members
1	**Dr. A. Veeraraghavan,** Professor, Department of Civil Engineering, IIT Madras, Room No:#234, Building Sciences Block, IIT Madras, Chennai-600036 (o) 044-22574272 Fax:044-22570509 Email: av@iitm.ac.in
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5	**Dr.R.V.Ranganath.** Dean (Academic), Principal Professor & HOD, Department of Civil Engineering, BMS College of Engineering, Bull Temple Road, Bangalore-560 019 Currently Principal BMSIT, Yelahanka, Bangalore (M) 98450-86602 Email: rangarv@yahoo.com

Program Educational Objectives (PEO's)

The programme educational objectives of the Civil Engineering of REVA University is to prepare graduates

PEO-1	To have successful professional careers in industry, government, academia and military as innovative engineers.
PEO-2	To successfully solve engineering problems associated with the lifecycle of Civil Engineering system, in particular transportation engineering by communicating effectively either leading a team or as a team member
PEO-3	To continue to learn and advance their careers through activities such as research and development, acquiring doctoral degree, participation in national level research programmes, teaching and research at university level etc.,
PEO-4	To be active members ready to serve the society locally and internationally, may take up entrepreneurship for the growth of economy and to generate employment; and adopt the philosophy of lifelong learning to be aligned with economic and technological development.

Program Outcomes (POs)

After successful completion of the programme, the graduates shall be able to

- PO1. **Demonstrate in-depth knowledge** of transportation engineering and management, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
- PO2. **Analyze complex engineering problems** critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in transportation engineering and management a wider theoretical, practical and policy context.
- PO3. **Think laterally and originally, conceptualize and solve engineering problems**, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in transportation engineering and management

- PO4. **Extract information pertinent to unfamiliar problems** through literature survey and experiments, apply appropriate **research methodologies, techniques and tools, design**, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in transportation engineering and management

- PO5. **Create, select, learn** and **apply** appropriate techniques, resources, and transportation **engineering and IT tools**, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

- PO6. Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to **collaborative-multidisciplinary scientific research**, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

- PO7. Demonstrate knowledge and understanding of transportation engineering and management principles and apply the same to one's own work, as a **member and leader in a team**, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

- PO8. **Communicate with the engineering community**, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

- PO9: Recognize the need for, and have the preparation and ability to engage in **life-long learning** independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

- PO10. Acquire professional and intellectual integrity, professional **code of conduct**, **ethics of research** and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

- PO11. Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and **learn from mistakes** without depending on external feedback **(SELF learning).**

Programme Specific Outcomes (PSO's)

1) Apply knowledge of Transportation Engineering and management in real time.
2) Analyse a system, component or process in the knowledge areas of Transportation Engineering in real time problems.
3) Design a system, component, or process in more than one areas of Transportation Engineering.
4) Conduct investigations and address complex Transportation engineering problems; Utilize and develop innovative tools and techniques that are appropriate in Transportation Engineering discipline.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
MTTE18F1010	CO1	3		3	3	3	3						3		3	
	CO2	3	3	3	3		2					3	3	3	3	3
	CO3	3	2		3		3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	2	3
M18TE1020	CO1	2				3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2
MTTE15F1300	CO1	2	3			3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2
MTTE15F1410	CO1	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2
M18TE1051	CO1	3	3	3		2	2	3	3		3		3	2	2	2
	CO2	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO3	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO4	3	2	3	2				3		2		3			2
M18TE1052	CO1			3		3						3	1	2		3
	CO2	3	3	3		3				3		3	2	2		
	CO3	3		3	3	3			3	3		3	2	2	3	
	CO4	3	3		3		3			3		3				3
M18TE1061	CO1	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2
M18TE1062	CO1	2		3	2	3	1	1			2	3	3	3	3	2
	CO2	2	2	2	3	3				3	2		3	3	3	2

	CO3	3	2		**2**	**3**	**3**	**2**		**2**	**3**		**3**	**3**	**3**	**1**
	CO4	2	3		**3**	**2**	**2**		**1**		**3**		**3**	**3**	**3**	**2**
M18TE1070	**CO1**	**3**	**2**	**2**	**-**	**2**	**3**	**-**		**3**	**2**	**2**	**3**	**2**	**1**	**2**
	CO2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**		**2**		**3**	**2**	**2**	**2**
	CO3	**3**	**2**	**2**	**2**	**2**		**2**		**3**	**2**	**2**	**3**	**3**	**2**	**2**
	CO4	**3**	**2**	**3**	**2**		**3**	**3**	**3**		**2**	**2**	**3**	**3**	**2**	**2**
M18TE2010	**CO1**	**3**	3	**2**		**3**			**3**				3		**3**	
	CO2		**3**	**3**		**3**						**3**	**3**	**3**	**3**	**3**
	CO3	**3**	**2**	**3**	**3**		**3**						**3**	**2**		
	CO4	**2**	**3**	**3**	**3**	**2**	**3**						**3**	**3**	**2**	**3**
M18TE2020	**CO1**	**3**		**3**	3	**3**	**3**						3		**3**	
	CO2	**3**	**3**	**3**	**3**		**2**					**3**	**3**	**3**	**3**	**3**
	CO3	**3**	**2**		**3**		**3**						**3**	**2**	**3**	
	CO4	**2**	**3**	**3**	**3**	**2**		**1**					**3**	**3**	**2**	**3**
MTTE18F2200	**CO1**	**2**	**2**		**2**	**3**		**2**					**1**	**2**	**1**	**2**
	CO2	**2**	**2**		**2**	**3**		**2**				**3**	**1**	**1**	**2**	**2**
	CO3	**2**				**2**		**3**					**1**	**2**	**1**	**2**
	CO4	**2**	**3**	**2**		**3**		**3**				**2**	**1**	**2**	**2**	**2**
M18TE2040	**CO1**			**3**		**2**				**2**		**2**	**3**	**3**	**3**	**2**
	CO2	3	3	**2**		**2**	**2**	**1**		**2**	**2**	**3**	**3**	**3**	**3**	**2**
	CO3	2	2	**3**	**3**		**2**				**3**	**3**	**3**	**3**	**3**	**1**
	CO4		3		**2**	**1**		**2**	**1**		**3**	**2**	**3**	**3**	**3**	**2**
M18TE2051	**CO1**		**3**	**3**		**3**							**2**	**2**		
	CO2		**3**		**3**	**3**						**3**		**2**		
	CO3		**3**	**3**	**3**	**3**			**3**			**3**	**2**	**2**		
	CO4															
MTTE15F2420	**CO1**		**3**	**3**		**3**							**2**	**2**		
	CO2		**3**		**3**	**3**						**3**		**2**		
	CO3		**3**	**3**	**3**	**3**			**3**			**3**	**2**	**2**		
	CO4															
M18TE2061	**CO1**		**2**	**3**		**3**			**3**			**3**	**2**	**2**		
	CO2	**2**			**3**		**3**					**3**	**3**	**3**		
	CO3	**2**			**3**		**3**			**3**		**3**	**3**	**3**		
	CO4	**2**			**3**		**3**	**3**					**2**	**3**		
M18TE2062	**CO1**	2	2				2	2	2				1	2		
	CO2	2	2					2	2				2	2	3	
	CO3	2	2		3			3	3				1	2	3	**2**
	CO4		2		3	3		2	2					2	3	**2**
M18TE2070	**CO1**	**3**	3	**3**	3	**3**	**3**						3		**3**	
	CO2	**2**	**3**	**3**	**3**							**3**	**3**	**3**	**3**	**1**
	CO3	**3**	**2**	**1**	**3**	**1**	**3**						**3**	**2**	**3**	
	CO4	**2**	**3**	**3**	**3**	**2**		**1**					**3**	**3**	**1**	**3**

M18TE3010	**CO1**	**2**	**3**		**1**		**2**		**1**	**1**			**3**			
	CO2	**3**	**2**		**2**	**2**	**2**	**3**		**2**			**3**		**1**	**2**
	CO3	**3**	**3**	**2**	**2**		**1**			**2**	**1**		**3**	**3**	**3**	**2**
	CO4	**3**					**3**	**3**	**2**	**2**			**3**			

Mapping of PEOS with Respect to POs

	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO4	√	√	√	√	√	√	√	√	√	√	√	√	√	√

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Master's Degree program. It is more focused towards the student's choice in providing a wide range of Units available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed Units available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the Units.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.

- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0. A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

2.1. Various course of s**tudy** are labeled and defined as: (i) Core Course (CC) (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Foundation Course (FC):**

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(iii) **Hard Core Course (HC):**

The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iv) **Soft Core Course (SC):**

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(v) O**pen Elective Course:**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **Six to Eight credits** is called **Minor Project** work.A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE, SIXTEEN or TWENTY** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be earned:

3.1. A candidate has to earn 96 credits for successful completion of M Tech degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 26 credits per Semester. However he / she may not successfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M .Tech degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 96 credits for the M. Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B. Tech degree. The A**dd - on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5.0. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 components as C1, C2, and C3.**The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component C1:

The first Component (C1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for C2 immediately after completion of process of C1.

The finer split - up for the award of marks in C1 is as follows:

Assignment ……..…….. 05 marks for Unit 1&2

Seminar ……..……. 05 marks for Unit 1&2

Test (Mid-Term) ……..……..15 marks for Unit 1&2

Total ……..…… ……..25 marks

(ii) Component C2:

The second component (C2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be

conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

The 17th week will be for revision of syllabus and preparation for the semester - end examination.

The finer split - up for the award of marks in C2 is as follows:

Assignment ……..……..... 05 marks for Unit 3 & 4

Seminar ……..……..……..05 marks for Unit 3 & 4

Review Test (Mid-Term) ……..…….15 marks for Unit 3 & 4

Total ……..……..25 marks

(iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

5.2. Setting Questions Papers and Evaluation of Answer Scripts:

5.2.1. There shall be three sets of questions papers set for each course. Two sets of question papers shall be set by the internal and one set by external examiner for a course. The Chairperson of the BoE shall get the question papers set by internal and external examiners.

5.2.2. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

5.2.3. There shall be single valuation for all theory papers by internal examiners. In case, the number of internal examiners falls short, external examiners may be invited. The answer scripts evaluated both by internal and external examiners shall be moderated by the external examiner / moderator.

5.2.4. The examination for Practical work/ Field work/Project work will be conducted jointly by two examiners (internal and external). However, in case of non-availability of external examiner or vice versa, the Chairperson BoE at his discretion can invite internal / external examiners as the case may be, if required.

5.2.5. If a course is fully of (L=0):T: (P=0) type, then the examination for C3 Component will be as decided by the BoS concerned.

5.2.6. In case of a course with only practical component a practical examination will be conducted with two examiners (ref: 6.3.4 above) and each candidate will be assessed on the basis of: a) Knowledge of relevant processes, b) Skills and operations involved, and c) Results / Products including calculation and reporting.

5.2.7. The duration for semester-end practical examination shall be decided by the School / Council.

5.3. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

5.4. The schedule of continuous assessment and examinations are summarized in the following Table below.

Component	Period	Syllabus	Weightage	Activity
C1	1st Week to 8th Week Last 3 days of 8th Week	First 50% (two units)	25%	Instructional process and Continuous Assessment
	1st Week to 8th Week Last 3 days of 8th Week	First 50% (two units)	25%	Consolidation of C1
C2	9th week to 16th week	Second 50% (remaining two units)	25%	Instructional process and Continuous Assessment
	Last 3 days of 16th week	Second 50% (remaining two units)		Consolidation of C2
C3	17th and 18th week			Revision and preparation for Semester end examination
	19th week to 20th week	Entire syllabus	50%	Conduct of semester end examination and Evaluation concurrently
	21st week			Notification of Final Grades
***Evaluation shall begin very first day after completion of the conduct of examination of the first course and both examination and evaluation shall continue concurrently. The examination results / final grades be announced latest by 21st week**				

Note: 1. Practical examination wherever applicable shall be conducted before conduct of C2 examination. The calendar of practical examination shall be decided by the respective school.

2. Finally**, awarding the Grades** be announced latest by 5 days after completion of the examination.

6.0 Requirements to Pass a Course

6.1. A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 30% in C1 and C2 together, and 40% and above in aggregate of C1, C2 and C3 in a course is said to be successful.

6.2. **Eligibility to Appear for C3 (Semester - end) Examination and Provision to Drop the Course.**
Only those students who fulfill 75% attendance requirement and who secure minimum 30% marks in C1 andC2 together in a course are eligible to appear for C3 examination in that course.

6.3. Those students who have 75% of attendance but have secured less than 30% marks in C1 and C2 together in a course are not eligible to appear for C3 examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.
Teachers offering the courses will place the above details in the School Council meeting during the last week of the Semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

6.4. In case a candidate secures more than 30% in C1 and C2 together but less than 40% in aggregate of C1, C2 and C3 in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for C3 examination during the subsequent semesters / years within the stipulated period.
In such a case wherein he / she opts to appear for just C3 examination, then the marks secured in C1 and C2 shall get continued. Repeat C3 examination will be conducted in respective semesters.

6.5. In case a candidate opts to drop the course he / she has to re-register for the dropped course only in subsequent semesters whenever it is offered if it is Hard Core Course and he / she may choose alternative course if it is Soft Core Course or Open Elective course or Skill Development Course.
The details of any dropped course will not appear in the Grade Card.

6.6. **Provision to Withdraw Course:**

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective. **A DROPPED course is automatically considered as a course withdrawn.**

7.0. Provision for Make- up Examination:

For those students who have secured less than 40% marks in C1, C2 and C3 (end semester examination) together; the university shall conduct a make-up C3 examination within three weeks after the end of each semester.

Such of those students who have secured more than 30% marks in C1 and C2 together and less than 40% marks in C1, C2, and C3 together in a course shall appear for make-up examination in that course. This make-up examination is only for C3examination.

A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance and performance requirements in C1 & C2 shall appear for make-up examination.

7.1 The candidate has to exercise his/her option immediately within 10 days from the date of notification of results. A MAKE-UP examination will be conducted within 25 days from the date of notification of results. If the candidate still remains unsuccessful after MAKE-UP examination he/she is said to have DROPPED that course

7.2 **Re-Registration and Re-Admission:**

A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for end semester examination (C3) shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

In case a candidate fails in more than 2 courses in odd and even semesters together in a given academic year, he / she may either drop all the courses and repeat the semester or reappear (C3 semester end examination) to such of those courses where in the candidate has failed during subsequent semester / year within a stipulated period.

7.3 In such a case where in a candidate drops all the courses in semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

7.4 **Requirements to Pass the Semester and Provision to Carry Forward the Failed Subjects / Courses:**

7.4.1 A candidate who secures a minimum of 30% in C1 and C2 and 40% and above in aggregate of C1, C2 and C3 in all the courses with credits prescribed in a semester is said to have passed that semester.

7.5. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in 4 courses in 1st and 2nd semesters together shall move to 3rd semester. And he / she shall appear for C3 examination of failed courses of the said semesters concurrently with 3rd semester end examinations (C3) and 4th semester end examinations (C3) of second year of study.

8.0 **Attendance Requirement:**

8.1. All students must attend every lecture, tutorial and practical classes.

8.2. In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

8.3. Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (C3) examination.

8.4. Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

8.5. **Absence during mid semester examination**

In case a student has been absent from a mid semester examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on

the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester examination.

8.6. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

9. **Provisional Grade Card:**

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).This statement will not contain the list of DROPPED courses.

9.1 **Challenge Valuation:**

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the Grade awarded to him/her by surrendering the Grade Card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for C3 component.

The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.

9.2 Final Grade Card: Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

9.3 The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	v*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail;

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

9.4 **Computation of SGPA and CGPA**

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA
Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A**	**9**	**4X9=36**
Course 2	**4**	**B**	**8**	**4X8=32**
Course 3	**4**	**C**	**7**	**4X7=28**
Course 4	**4**	**O**	**10**	**4X10=40**
Course 5	**4**	**D**	**6**	**4X6=24**
Course 6	**4**	**O**	**10**	**4X10=40**
	24			**200**

Thus, **SGPA = 200 ÷ 24 = 8.33**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**5**	**A**	**9**	**5X9=45**
Course 2	**5**	**C**	**7**	**5X7=35**
Course 3	**5**	**A**	**9**	**5X9=45**
Course 4	**5**	**B**	**8**	**5X8=40**
Course 5	**4**	**O**	**10**	**4X10=40**
	24			**205**

Thus, **SGPA = 205 ÷ 24 = 8.54**

9.5 Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for two year post graduate degree in Computer Science & Engineering is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 =204.96
3	24	9.35	24x9.35=224.4
4	24	9.50	24x9.50=228.0
Cumulative	96		857.28

Thus, **CGPA** = $\frac{24x8.33+24x8.54+24x9.35+24x9.50}{96}$ = 8.93

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.93 x 10=89.30

9.6 Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Numerical Index	FGP
		Qualitative Index
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

10.0. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

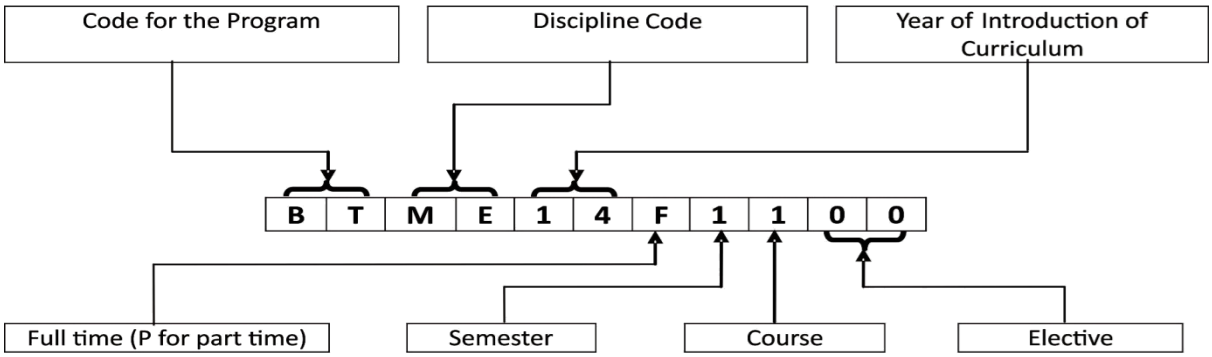
11.0. Grievance Cell

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

12.0. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering /
MA	Master of Arts	DE	Data Engineering and Cloud
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

REVA UNIVERSITY
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SCHOOL OF CIVIL ENGINEERING
M.Tech. COURSE CURRICULUM SCEEME FROM: 2018-2020
Specialisation: TRANSPORTATION ENGINEERING AND MANAGEMENT (TE)

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/SC/OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18TE1010	Traffic Engineering	HC	B.E/ B. Tech Civil Engineering	3	1	-	4	5
2	M18TE1020	Highway Materials and Testing	HC		3	1	-	4	5
3	M18TE1030	Ground Improvement Techniques	HC		3	1	-	4	5
4	M18TE1040	Railways and Airways	HC		3	1	-	4	5
5	M18TE1051	Geometric Design of Highways	SC		3	1	-	4	5
	M18TE1052	Intelligent Transportation Systems			3	1	-	4	5
6	M18TE1061	Development of Rural Infrastructures	SC		3	1	-	4	5
	M18TE1062	Road Safety and Management			3	1	-	4	5
TOTAL								**24**	**30**
Practical									
7	M18TE1070	Highway Materials testing and Pavement Evaluation laboratory	HC		-	-	4	4	3
TOTAL								**04**	**03**
TOTAL SEMESTER CREDITS								**28**	
TOTAL CUMULATIVE CREDITS								**28**	
TOTAL CONTACT HOURS								**33**	

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II SEMESTER

Sl. No	Course Code	Title of the Course	HC/SC/OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18TE2010	Applied Traffic Engineering	HC	B.E/ B. Tech Civil Engineering	3	1	-	4	5
2	M18TE2020	Pavement Analysis and Design	HC		3	1	-	4	5
3	M18TE2030	Urban Transport Planning	HC		3	1	-	4	5
4	M18TE2040	Highway Economics and Finance	HC		3	1	-	4	5
5	M18TE2051	Pavement Evaluation and management system	SC		3	1	-	4	5
	M18TE2052	Transportation System Management			3	1	-	4	5
6	M18TE2061	Highway Construction and Maintenance	SC		3	1	-	4	5
	M18TE2062	Planning and Management of Highway Projects			3	1	-	4	5
TOTAL								**24**	**30**
Practical									
7	M18TE2070	Traffic Engineering Laboratory	HC		-	-	4	4	3
TOTAL								**04**	**03**
TOTAL SEMESTER CREDITS								**28**	
TOTAL CUMULATIVE CREDITS								**56**	
TOTAL CONTACT HOURS								**33**	

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III SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Term Work / Sessions	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18SE3010/ M18TE3010	Roads and Building Structures	OE	B.E/ B. Tech Civil Engineering	4	0	0	04	04
2	M18TE3020	Internship with Report	Term Work and Viva - Voce		0	0	0	12	
3	M18TE3030	Project Phase-I	Report and Viva -Voce		0	0	0	04	
TOTAL								**20**	
TOTAL SEMESTER CREDITS								**20**	
TOTAL CUMULATIVE CREDITS								**76**	
TOTAL CONTACT HOURS								**04**	

Note: 1) OPEN ELECTIVE Courses are offered for the students of other Schools. The students of the School of Civil Engineering have to **Choose ONE Open Elective offered by other schools**.

2) Open Elective Classes will be conducted on Saturday's only

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF CIVIL ENGINEERING
M.Tech. COURSE CURRICULUM SCEEME FROM: 2018-2020
Specialisation: TRANSPORTATION ENGINEERING AND MANAGEMENT (TE)

IV SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Team Work / Sessions	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18TE4010	Technical Seminar with Report	Team Work		0	0	0	04	
2	M18TE4020	Dissertation	Thesis Submission and Viva-Voce		0	0	0	16	
TOTAL									
TOTAL SEMESTER CREDITS								**20**	
TOTAL CUMULATIVE CREDITS								**96**	
TOTAL CONTACT HOURS								**-**	

PROGRAMME OUTCOMES (PO's):

On successful completion of the Programme the students shall be able to:

a. Apply the fundamental knowledge of mathematics topics like calculus, matrix theory, and finite differences, Optimization methods and the fundamental knowledge of physics, chemistryand basic Engineering.

b. Design and conduct experiments, as well as to analyze andnterpret data

c. Design a system, component or process to meet desired needs within realistic constraintssuch as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. Function on multidisciplinary teams

e. Identify, formulate, and solve Civil Engineering problems in accordance with the relevant standard codes of practice

f. Understand the role of Civil Engineers and ethical responsibility

g. Communicate effectively through verbal, written, and graphical modes.

h. Perform on the basis of broad education necessary to understand the impact of engineeringsolutions in a global, economic, environmental, and societal context

i. Recognize the need for, and an ability to engage in life-long learning

j. Incorporate specific contemporary issues into the identification, formulation, and solution of a specific civil engineering problems

k. Use the techniques, skills, and modern civil engineering tools necessary for engineering practice

Course code	Course Title	Duration		L	T	P	C
M18TE1010	Traffic Engineering	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Provide an insight on traffic and its components, factors affecting road traffic
- Explain the objectives, data collection, analysis and interpretation of various surveys
- Illustrate the application of statistical tools in traffic engineering
- Provide an insight on traffic regulations and the various control devices including signals

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Describe the characteristics of traffic and its components, and analyze the factors affecting road traffic
- Conduct various traffic surveys and analyse the data and suggest the required measures
- Apply statistical tools for interpreting traffic data and test the significance
- Classify the traffic regulations, design traffic control devices including redesign of existing signals

Course Contents:

Traffic Characteristics: Objectives and scope of traffic engineering. Components of road traffic: the vehicle, driver and road. Road user characteristics: human and vehicular characteristics. Traffic manoeuvres and Stream Characteristics. Passenger Car Units. Numerical examples.

Unit-2 **12 hours**

Traffic Engineering Studies and Analysis: Objectives, methods of conducting, equipment, data collection, analysis and interpretation of the following studies: (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - Destination (v) Parking (vi) Accident. Numerical examples.

Unit-3 **12 hours**

Statistical Methods for Traffic Engineering: Measures of central tendency, variance. Concepts of probability. Binomial, Poisson and Normal distributions. Sampling theory and significance testing. Regression and correlation. Numerical examples.

Unit-4 **12 hours**

Traffic Regulation and Control: Driver, vehicle, traffic flow and general regulations and control. Traffic Control Devices: traffic signs, markings, islands and signals. Different methods of signal design. Signal system and co-ordination. Numerical examples.

Reference Books:

- Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee - 2014.
- Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publishers, Delhi – 2007.
- Papacostas, C.A., 'Fundamentals of Transportation Engineering', Prentice-Hall of India Private Limited, New Delhi - 2000.
- Jotin Khisty, C., and Kent Lall. B., 'Transportation Engineering – An Introduction', PHI Learning Private Limited, New Delhi - 2013.
- Relevant IRC Publications.

Assignment/Self Studies:

1. Driver characteristics
2. Pedestrian studies
3. Vehicular characteristics
4. Spot speed studies
5. Speed and delay studies
6. Volume studies
7. Turning movement studies
8. Origin and destination studies
9. Parking inventory studies
10. Parking demand studies
11. Accident data collection
12. Individual accident studies
13. Traffic signage studies
14. Black spot investigations
15. General case study
16. General case study

Mapping of Po's and Co's

Course Code	POS/ COs	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO 11	PSO1	PSO2	PSO 3	PS 4
MTTE18F 1010	CO1	3		3	3	3	3						3		3	
	CO2	3	3	3	3		2					3	3	3	3	3
	CO3	3	2		3		3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	2	3

Course code	Course Title	Duration		L	T	P	C
M18TE1020	Highway Materials and Testing	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Explains the origin, properties, constituents and different test procedures and specifications of soil
- Provide the overview about aggregate properties and tests to be carried out
- Provides the knowledge about the bitumen and bitumen mixes.
- Provide an overview of cement concrete pavements and soil stabilization.

Course Outcomes:

At the end of the course, the student are expected to be able to

- Describe the properties of soil, and its tests
- Analyse the properties of aggregates and tests on field.
- Analyse the tests and properties of bitumen mixes.
- Evaluate cement concrete pavements and soil stabilization techniques

Course Contents

Unit-1 **12 hours**

Basic road construction materials: Soils, aggregates, bitumen and Portland cement – types, source, functions, requirements, properties, tests and specifications for use in various components of road, Rothfutch's and Critical sieve methods- Numerical examples

Unit-2 **12 hours**

Aggregates: Origin, classification, requirements, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Aggregate gradation and Shape factor in mix design- Numerical examples.

Unit-3 **12 hours**

Bituminous Binders and Mixtures: Different types, properties and uses, physical tests on bitumen, bitumen mixes, Modified binders, ideal pavement binders, Marshall Method of mix design, Criteria and super pave mix design, Additives and Modifiers in Bituminous mixes – Numerical examples

Unit-4 **12 hours**

Cement concrete in road works: Tests, design of mix for CC pavement, use of additives, joint filler and sealer materials. **Soil stabilization:** Methods and tests, proportioning of materials and mix design, application of Rothfutch's method. Use of chemical stabilizers like RBI -81, soil fix etc in road construction.

Reference Books:

- MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
- Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee
- Khanna and Justo, "Highway Materials Testing"- Nem Chand and Bros., Roorkee.
- "Soil Mechanics for Road Engineers"- HMSO Publication
- Khanna, S.K., Justo, C.E.G., 'Highway Material Testing Manual'

Assignment/Self Study:

1. Grain sieve analysis and consistency limits , indices and soil classification
2. Crushing test , Impact test
3. Abrasion test, Soundness test
4. Shape test, Specific gravity and water absorption test
5. Bitumen adhesion test
6. Penetration test
7. Viscosity test
8. Specific gravity test
9. Flash and fire point test
10. Ductility and elastic recovery test
11. Softening point test and separation test
12. Tests on bitumen Emulsion and Cutback bitumen
13. Proportioning of materials by Rothfutch's method
14. Mix design by Marshall Method.
15. Evaluation of CBR strength of soils
16. Plate bearing test
17. Mapping of Po's and Co's

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
M18TE1020	CO1	2				3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2

Course code	Course Title	Duration		L	T	P	C
M18TE1030	Ground Improvement Techniques	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

a. Objectives: The overall objective of the Course is to enable students to:

- To introduce engineering properties of soft, weak and compressible deposits, principles of treatment for granular and cohesive soils and various stabilization techniques.
- To understand Ground improvement by compaction, consolidation, chemical and confinement methods.
- To bring out concepts of reinforced earth.

b. Learning Outcomes

(Maximum 4 outcomes per course and 1 outcome per unit. Units: 04 Units)

After completion of course students are able to
CO1
Classify different type of ground improvement techniques, different ground improvement methods for different problematic soils.
CO2
Explain suitability of hydraulic modification of ground improvement for saturated soils with and without vertical drains. Selection of different drainage techniques.
CO3.
Understand and design reinforced earth for different earth structures.
CO4.
Explain different types of grouting, grout materials and confinements used for ground improvement.

Course Contents:

Unit-1 **12 hours**

Ground improvements: Role of ground improvement in foundation engineering – methods of ground improvement –Geotechnical problems in alluvial, laterite and black cotton soils -Selection of suitable ground improvement techniques based on soil condition.

Unit-2 **12 hours**

Hydraulic modification: Definition, Methods of dewatering, Preloading with and without vertical drains. Drainage techniques – Well points – Vaccum and electro-osmotic methods – Seepage analysis for two dimensional flow-fully and partially penetrating slots in homogenous deposits (Simple cases only).

Unit-3 **12 hours**

Soil reinforcement: Concept of reinforced earth – Mechanisms – Types of reinforcements – Internal and External stability criteria pertaining to retaining walls– Design Principles of steep reinforced soil slops – pavements – Embankments on soft soils, Introduction to soil nailing concepts Applications of reinforced earth – use of Geotextiles for filtration, drainage and separation in road and other works.

Unit-4 **12 hours**

Grouting: Introduction, Chemicals and materials used. Types of grouting, grouting procedure, applications of grouting. Thermal methods, Crib walls, Gabions and Mattresses, Anchors, Rock bolts, Stone Column, Micropiles. Improvement of soft grounds and low lands; Treatment for problematic soils.

REFERENCE BOOKS

1. Koerner R.M., "Construction and Geotechnical Methods in Foundation Engineering", McGraw-Hill, 1994.
2. Purushothama Raj, P. "Ground Improvement Techniques", Tata McGraw-Hill Publishing Company, New Delhi, 1995
3. Moseley M.P., Ground Improvement Blockie Academic and Professional, Chapman and Hall, Glassgow, 1993.
4. Jones J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1995.
5. Koerner, R.M., "Design with Geosynthetics", (3rd Edition) Prentice Hall, New Jersey, 2002
6. Jewell, R.A., "Soil Reinforcement with Geotextiles", CIRIA special publication, London, 1996
7. Das, B.M., "Principles of Foundation Engineering", Thomson Books / Cole, 2003.
8. Hausmann M.R., "Engineering Principles of Ground Modification", McGraw-Hill Pub. Co., New York -1990.
9. Winterkorn H.F. and Fong H.Y. "Foundation Engineering Hand Book", Galgotia Book Source, New Delhi - 2000.
10. Sivakumar Babu G.L., "An introduction to Soil Reinforcement and Geosynthetics", Universities Press, Hyderabad – 2006.
11. Swami Saran, "Reinforced Soil and its Engineering Applications", I. K. International Pvt. Ltd, New Delhi - 2006.

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
MTTE15F1300	CO1	2	3			3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2

Course code	Course Title	Duration		L	T	P	C
M18TE1040	Railways and Airways	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Provides the basic knowledge about the railways, components
- Provide the basic knowledge about the geometric design of points and crossings.
- Provides the basic knowledge about airports, runways, taxiways and its design.
- Provide basic knowledge about heliports, characteristics, design of heliports

Course Outcomes:

At the end of the course, the student are expected to be able to

- Describe about railways and its design.
- Analyze the points and crossings.
- Describe about airports design and runways.
- Analyze the design of heliports.

Course Contents:

Unit-1 **12 hours**

Introduction: Permanent way and its requirements, Gauges and types, Typical cross sections, Coning of wheels and Tilting of rails, **Components**- Types, sections length- Defects- wear- creep- welding- joints. Track fitting and fastener, Calculation of quantity of materials, **Tractive resistances** and hauling capacity- Numerical examples

Unit-2 **12 hours**

Geometric Design: Necessity, Safe speed on curves. Cant, cant deficiency, negative cant, safe speed, Transition curve, gradient, grade compensation **Points and Crossings:** Components of a turnout, design of turnouts, types of switches, crossings, track junctions. Stations and yards. Signaling: Objects and types of signals. Fouling mark, buffer stop, level crossing, track defects- Numerical examples

Unit-3 **12 hours**

Introduction: Components and Site selection of airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose-Numerical examples. **Runway:** Basic runway length-Corrections and examples, Runway geometrics,

Unit-4 **12 hours**

Taxiway: Factors affecting the layout - geometrics of taxiway-Design of exit taxiway - Numerical examples. Visual aids- Airport marking – lighting-Instrumental Landing System.

Heliports and their Design: Introduction, Helicopter characteristics, planning of heliports, Visual aids of heliports

Reference Books:

- Saxena and Arora, "Railway Engineering" Dhanpat Rai and Sons, New Delhi
- M M Agarwal," Indian Railway Track", Jaico Publications, Bombay
- Khanna Arora and Jain, "Airport Planning and Design", Nem Chand Bros, Roorkee
- R Srinivasan, "Docks and Tunnel Engineering", Charotar Publishing House
- H P Oza and G H Oza, "Docks and Harbour Engineering", Charotar Publishing House
- B C Punmia, "Surveying", Laxmi Publications
- Mundrey, "Railway Engineering", McGraw Hill Publications

Mapping of Po's and Co's

Course Code		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
MTTE15F1410	CO1	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2

Course code	Course Title	Duration		L	T	P	C
M18TE1051	Geometric Design of Highways	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Provide an insight into the geometric design of highways and the cross section elements
- Provide an understanding of the sight distance requirements along highways and their design
- Provide an understanding of the horizontal and vertical alignment elements and their design
- Provide an overview of the importance of highway drainage and its components

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Describe the elements of geometric design, the design criteria and the cross sectional elements
- Analyse and design the sight distances for various requirements
- Analyse and design the elements of horizontal and vertical alignment
- Describe the systems and design the components of highway drainage

Course Contents

Unit-1 **12 hours**

Design Controls: Elements of geometric design, design controls and criteria. **Cross Section Elements:** Pavement surface characteristics, width considerations for various components of cross section elements, right of way. **Sight Distances:** Types, analysis and design. – Numerical examples.

Unit-2 **12 hours**

Geometric design provision for various transportation on facilities as per IRC guidelines, geometric design of horizontal and vertical alignment, design of expressways/ high speed corridors.

Unit-3 **12 hours**

Design of at grade intersections: Principles of design, channelization, roundabouts, staggered intersections. **Geometric design of facilities for non motorized traffic:** Bicycles and pedestrian facility design, slow carriageways

Unit-4 **12 hours**

Highway Drainage: Objects and requirements of highway drainage. Surface drainage systems – analysis and design. Sub-surface drainage systems types and design. Drainage of hill roads – components and maintenance. Drainage of slopes and erosion control. - Numerical examples.

Reference Books:

- Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee - 2014.
- Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publishers, Delhi – 2007.
- AASHO, "A Policy on Geometric Design of Highways and Streets', American Association of State Highway and Transportation Officials, Washington D.C.
- Jack E Leish and Associates, `Planning and Design Guide: At-Grade Intersections'. Illinois.
- Relevant IRC publications

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18TE1051	CO1	3	3	3		2	2	3	3		3		3	2	2	2
	CO2	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO3	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO4	3	2	3	2				3		2		3			2

Course code	Course Title	Duration		L	T	P	C
M18TE1052	Intelligent Transportation Systems	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Provide an insight on various taxonomy of ITS
- To explain the various components of ITS
- Illustrate the application and functions of ITS
- Various ITS technologies around the world

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Describe the taxonomy of ITS and the technologies in ITS
- Explain the various components and the architecture of ITS
- Illustrate the services of ITS
- Classify the different ITS technologies around the world

Course Contents:

Unit-I **12 hours**

Introduction: ITS, History of ITS, ITS Taxonomy- vehicle level, infrastructure level, corporate level, Enabling Technologies- data acquisition, data communication, data processing, information distribution, information utilization.

Unit-II **12 hours**

Components of ITS: data acquisition – sensors, AVI, AVL, GPS; communication tools, data analysis, traveler information. **ITS architecture:** Transit Management Centre, Traffic Management Centre, Emergency Management Centre.

Unit-III **12 hours**

ITS user services: Traffic Management, Travel Information, Vehicle system, Commercial vehicle operations, Public transport system, Emergency Management, Electronic Payment and Safety. **Functional areas of ITS:** ATMS, ATIS, CVO, APTS, EMS, EP, ARTS

Unit-IV **12 hours**

Case studies: India, US, UK, Japan, Middle East, Canada Issues and challenges of ITS.

Reference Books:

- ITS Hand book 1998, Safety And Comfort For Society In The 21st Century, Japan
- Roger R Stough, "Intelligent Transport System- case studies and policies".
- Richard Whelan – "Smart Highways, Smart Cars – Artech House Boston , Londen.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE1052	CO1			3		3						3	1	2		3
	CO2	3	3	3		3				3		3	2	2		
	CO3	3		3	3	3			3	3		3	2	2	3	
	CO4	3	3		3		3			3		3				3

Course code	Course Title	Duration		L	T	P	C
M18TE1061	Development of Rural Infrastructures	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Objectives:

1. To enable the students to understand nature of Rural Infrastructure
2. To make familiar the students about development process & Rural Infrastructure
3. To enable the students to understand Rural Communication

Course Outcomes:

At the end of the course, the students is expected to be able to:

1. To understand nature of Rural Infrastructure
2. To get the knowledge about development process & Rural Infrastructure
3. To get knowledge about Social Infrastructure
3. To learn and understand Rural Communication

Course Contents:

Unit-I **12 hours**

Rural Infrastructure: Definition, Components - Importance of Rural Infrastructure, Growth of Rural Infrastructure - Infrastructure Policy - Rural Infrastructure Development Fund (RIDF)

Unit-II **12 hours**

Rural Transportation: Type of Structure - Road and Rail Co-ordination - Rural Transportation Problems - Various Schemes for Rural Roads Development of India / PMGSY

Unit-III **12 hours**

Social Infrastructure: Concept - Components of Social Infrastructure, Education, Health, Drinking Water - Sanitations - Issues, Problems and Remedies, Smart villages.

Unit-IV **12 hours**

Rural Communication and Information Communication Technology: Need, Sources, technology and Rural Communication, Issues and problems - Government policies for Rural Communication

Rural Energy: Meaning and types - Sources of Rural energy, Rural electrification Problems, Remedies and Programmes - Non-Renewable Energy.

Text Books:

1. Dutt and Sundaram - Indian Economy, S.Chand Publications, New Delhi, 2013-07-02
2. Vasant Desai: Rural Development in India, Himalaya Publishing House, Mumbai 2012.
3. Mishra S.K. and Puri V.K. - Economics of Development and Planning, Himalaya Publishing House, Mumbai, 2012

Reference Books:

1. Sukhadeo Thorat, Samita Sirohi - Rural Infrastracture, Volume IV
2. A.N. Agarawal- India Economy, Vikas Publication House, Delhi
3. P. Adinarayana Reddy - Rurastructure and Development

Mapping of Po's and Co's

Course Code		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
M18TE1061	CO1	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2

Course code	Course Title	Duration		L	T	P	C
M18TE1062	Road Safety and Management	16 Weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Explain different parameters responsible for road accident
- Describe the investigation procedure of an accident
- Discuss various measures for reducing accident rate
- Define traffic control devices for reducing accident.

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Recognize the factors affecting road safety
- Illustrate the factors affecting the reconstruction of existing roads
- Remember and illustrate the process of road safety audit and the measures of improving road safety. Qualified to evaluate the effectiveness of various management techniques adopted in reducing road accident.
- Classify the different traffic control devices.

Course Contents:

Unit-1 **12 hours**

Road Accident: definition, categorisation of accident data, collection of accident data. Condition and collision diagram. Causes of accident.

Unit-2 **12 hours**

Accident investigation; measures for reducing accident rate – engineering, enforcement, education, accident investigation and analysis, problems

Unit-3 **12 hours**

Traffic calming techniques, economic evaluation by before and after studies, numericals. Counter measures for different accident, local area management, road safety audit

Unit-4 **12 hours**

Traffic Control Devices: traffic signs, markings, islands and signals. Different methods of signal design. Signal system and co-ordination. Numerical examples **Reference Books:**

- Babkov, V.F. 'Road conditions and Traffic Safety', MIR publications, Moscow - 1975.
- K.W. Ogden, `Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
- Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
- Jotin Kishty and B. Kent Lall, 'Transportation Engineering-An Introduction', Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006
- Relevant IRC Publications.
- MORTH "Manual for Road Safety in Road Design"- Indian Roads Congress

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE1062	**CO1**	**2**		**3**	**2**	**3**	**1**	**1**			**2**	**3**	**3**	**3**	**3**	**2**
	CO2	2	2	**2**	**3**	**3**				**3**	**2**		**3**	**3**	**3**	**2**
	CO3	3	2		**2**	**3**	**3**	**2**		**2**	**3**		**3**	**3**	**3**	**1**
	CO4	2	3		**3**	**2**	**2**		**1**		**3**		**3**	**3**	**3**	**2**

Course code	Course Title	Duration		L	T	P	C
M18TE1070	**Highway Materials Testing and Pavement Evaluation laboratory**	**16 Weeks**	**HC**	**0**	**0**	**4**	**3**
Internal assessment: 20 Marks		**Semester End Exam: 30 Marks(Minimum 08 Marks)**					

Course Prerequisite: None

Course Learning Objectives:

- Explains the origin, properties, constituents and different test procedures and specifications of soil
- Provide the overview about aggregate properties and tests to be carried out
- Provides the knowledge about the bitumen and bitumen mixes.
- Provide an overview of cement concrete pavements and soil stabilization.

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Conduct all types of tests on soil and Aggregates
- Conduct all types of tests on Bitumen and cement
- Evaluate all types of roads with the help of Evaluation equipments
- Conduct all types of tests on soil.

Course Contents

Unit-1 **12 hours**

Tests on Basic road construction materials: Soils, aggregatestypes, source, functions, requirements, properties, tests and specifications for use in various components of road, Rothfutch's and Critical sieve methods

Unit-2 **12 hours**

Tests on Bituminous Binders and Mixtures: Different types, properties and uses, physical tests on bitumen, bitumen mixes, Modified binders, ideal pavement binders, Marshall Method of mix design, Criteria and super pave mix design, Additives and Modifiers in Bituminous mixes –

Unit-3 **12 hours**

Pavement Evaluation Studies: Structural Evaluation techniques (Tests), Functional Evaluation techniques (Tests)

Unit-4 **12 hours**

Preparation of quality control manual for different types of Transpiration projects and Quality control Documentation.

Reference Books:

- Relevant IRC and IS code Books.
- MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
- Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee
- Khanna and Justo, "Highway Materials Testing"- Nem Chand and Bros., Roorkee.
- "Soil Mechanics for Road Engineers"- HMSO Publication
- Khanna, S.K., Justo, C.E.G., 'Highway Material Testing Manual'

Mapping of Po's and Co's

Course Code		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
M18TE1070	**CO1**	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2

SECOND SEMESTER

Course code	Course Title	Duration		L	T	P	C
M18TE2010	Applied Traffic Engineering	16 Weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: Traffic Engineering

Course Learning Objectives:

- Provide an insight into the parameters of traffic flow and the various traffic flow theories
- Provide an insight into vehicle arrivals, gaps, headways and delays at uncontrolled intersections
- Provide an understanding of the various factors affecting capacity and level of service
- Provide an overview of various types of intersections and the requirements of buses and pedestrians

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Describe the parameters of traffic flow and apply the flow relationships at toll booths, diversions, bottlenecks etc.
- Analyse the gaps and headways of vehicle arrivals at ramps and interchanges and evaluate the delays
- Evaluate the capacity of highway facilities including intersections and judge the level of service
- Evaluate and design the various types of intersections and facilities for buses and pedestrians.

Course Contents:

Unit-I **12 hours**

Traffic Flow Theory: Fundamental diagram of traffic flow. Relationship between traffic flow parameters. Traffic flow theories – Lighthill and Whitham's theory, Car-following theory and Queuing theory – applications. Numerical examples.

Unit-II **12 hours**

Probabilistic Aspects of Traffic Flow: Spacing and Headway, Poisson distribution of vehicle arrivals. Gap and headway distribution. Exponential, shifted exponential and other distributions. Gap acceptance. Delays at uncontrolled intersections. Applications and numerical examples.

Unit-III **12 hours**

Highway Capacity: Definitions and factors affecting capacity. Concept of level of service. Capacity of rural highways and urban streets. Capacity of weaving sections. Capacity of signalised

intersections. Applications and numerical examples

Unit-IV **12 hours**

Design of Intersections: Types of intersections, characteristics and design considerations of at-grade intersections including rotary - warrants, design and suitability. Grade separated intersections - types, warrants and suitability. Facilities for buses and pedestrians. – Numerical examples.

Assignment/ Self Study:

1. Traffic flow parameters at mid-block sections
2. Traffic flow parameters at bottlenecks
3. Traffic flow parameters at toll booths
4. Vehicle arrivals – gap distribution
5. Vehicle arrivals – counting distribution
6. Gap acceptance – case study
7. Delays at uncontrolled intersections
8. Delays at signalised intersections
9. Capacity determination of rural highway - case study
10. Capacity determination of urban arterial - case study
11. Capacity determination of signalised intersection - case study
12. Capacity determination of weaving section - case study
13. Study and evaluation of at-grade intersection – case study
14. Study and evaluation of grade separated intersection – case study
15. Traffic simulation
16. Traffic simulation

Reference Books:

- Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee - 2014.
- Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publishers, Delhi – 2007.
- Papacostas, C.A., 'Fundamentals of Transportation Engineering', Prentice-Hall of India Private Limited, New Delhi - 2000.
- William R .McShane and Roger P.Roess., 'Traffic Engineering', Prentice Hall, New Jersey - 2000.
- Drew, D.R., 'Traffic Flow Theory and Control', McGraw Hill Book Co
- Pignataro, Louis; 'Traffic Engineering-Theory and Practice', John Wiley.
- Relevant IRC Publications.

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
M18TE2010	CO1	3	3	2		3			3				3		3	
	CO2		3	3		3						3	3	3	3	3
	CO3	3	2	3	3		3						3	2		
	CO4	2	3	3	3	2	3						3	3	2	3

Course code	Course Title	Duration		L	T	P	C
M18TE2020	Pavement Analysis and Design	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: MTTE15F120 - Highway Materials and Testing

Course Learning Objectives:

- Provide the factors affecting design and performance of pavements and different terms related to pavement design.
- Provide different methods of multi-layer systems.
- Provide the different designs used to analyse flexible pavement.
- Explain different design methods for rigid pavement.

Course Outcomes:

At the end of the course, students are expected to be able to

- List various factors affecting design and performance of pavements.
- Design multi-layer pavements
- Design flexible pavements using different methods
- Design rigid pavements using different methods.

Course Contents:

Unit-I **12 hours**

Introduction: Factors Affecting Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concept, Lane Distributions and Vehicle Damage Factors, Subgrade support - CBR and plate bearing tests, CSA, - Numerical examples

Unit-II **12 hours**

Stresses in Flexible Pavements: Stresses and deflections in homogenous masses. Burmister's two-layer theory, three layer Numerical examples. **Design of Flexible Pavements:** Design Methods Principle, design steps, advantages and applications of different pavement design methods IRC: 37-2001, AASHTO and Asphalt Institute methods- Numerical examples

Unit-III **12 hours**

Stresses In Rigid Pavements: Factors affecting design and performance of rigid pavements. Types of stresses and causes, factors influencing the stresses, EWL, stresses, loading positions - Numerical examples.

Unit-IV **12 hours**

Design of Rigid Pavements: IRC: 58-2011 method of design by stress ratio method. Design of continuously reinforced concrete pavements and airfield pavements. Problems on above, Design features of CRCP, SFRC and ICBP- Numerical examples.

Self-Study:

1. Any one Pavement Design software

Reference Books:

- Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chand and Bros, Roorkee.
- Yoder, E.J., and Witzack, 'Principles of Pavement Design', 2nd Edition, John Wiley and Sons
- Yang H.Huang, 'Pavement Analysis and Design', Prentice Hall Inc
- Relevant IRC Publications.
- Yang, "Design of functional pavements"- Mc Graw Hill Book Co.

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
M18TE2020	CO1	3		3	3	3	3						3		3	
	CO2	3	3	3	3		2					3	3	3	3	3
	CO3	3	2		3		3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	2	3

Course code	Course Title	Duration		L	T	P	C
M18TE2030	Urban Transport Planning	16 weeks	HC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Outline the Historical Development of Transportation in cities
- Explain the methods of data collection and analysis of Data
- Introducing four stages of urban transportation planning i.e., trip generation, trip distribution, mode choice modeling and route assignment.
- Integrating land use with transportation and compare land use models

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Illustrate the transportation planning process activities
- Analyse the required data by performing Transportation surveys
- Give exposure to land-use transport models.
- Assess applicability of land use models for solving urban transport problems
- undertake a complete transportation planning exercise for a city.

Course Contents:

Unit-I **12 hours**

Urban Transportation System Planning - Conceptual Aspects: Transport and Socioeconomic Activities, Historical Development of Transport, Transportation in the Cities, Freight Transportation, Future Developments, Transport Planning Process, Problem Definition, Solution Generation, Solution Analysis, Evaluation and Choice, Implementation, Sequence of Activities Involved in Transport Analysis, Transport demand and Supply, Travel demand forecasting process, Interrelationship of transport problems and transport models

Unit-II **12 hours**

Transportation Survey:
Definition of Study Area Zoning, Types of Movements, Types of Surveys, Home-Interview Survey, commercial Vehicle Survey, Intermediate Public Transport Survey, Cordon-Line Survey, Post-Card Questionnaire Survey, Registration-Number Survey, Tag-on-Vehicle Survey
Mode of Choice Modelling:
Influencing Factors, Earlier Modal Split Models, Trip-End Type Modal Split Model, Trip-Interchange Modal Split Model, Disaggregate Mode-Choice Model, Logit Model of Mode-Choice, Binary Choice Situations, Multinomial Logit Model, Model Calibration, Case Studies.

Unit-III **12 hours**

Trip Generation Analysis:Classification of Trips, Factors influencing trip generation, multiple regression analysis, Category Analysis Numerical examples

Trip Distribution Analysis:

Presentation of Trip-Distribution Data, PA Matrix to OD Matrix, Basis of Trip Distribution, Gravity Models and synthetic models of Trip Distribution, Calibration of Gravity Model, Singly and Doubly Constrained, Gravity Models, Case Studies.

Unit-IV **12 hours**

Route Assignment:Description of Transport Network, Route Choice Behavior, Route Assignment Techniques, All-or-Nothing Assignment, Multipath Traffic Assignment, Capacity-Restrained Traffic Assignment

Transport Related Land-use Models: Development of Land-use Models, The Lowry Model, Application of Lowry Model. **Case Study:** Detailed discussion on CTTP report of any metropolitan city of India.

Self study

1. Home interview survey
2. Commercial vehicle survey
3. Cordon-line survey
4. Registration number survey
5. Public transport survey
6. Origin-destination survey
7. Post-Card Questionnaire Survey

Reference Books:

- Ortuzar, J.D.D. and Willumsen, L.G. "Modelling Transport", John Wiley & Sons, 1990.
- Hutchinson, B.G., "Principles of Urban Transport Systems Planning", McGraw Hill Book Company, 1974.
- Kadiyali, L.R., "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 2006.
- Papacostas, C.A., 'Fundamentals of Transportation Engineering', Prentice-Hall of India Private Limited, New Delhi - 2000.
- Relevant IRC Publications.

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO4
MTTE18F2200	CO1	2	2		2	3		2					1	2	1	2
	CO2	2	2		2	3		2				3	1	1	2	2
	CO3	2				2		3					1	2	1	2
	CO4	2	3	2		3		3				2	1	2	2	2

Course code	Course Title	Duration		L	T	P	C
M18TE2040	Highway Economics And Finance	16 Weeks	HC	3	1	4	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Explain the basic terminology of economics and its application in transportation
- Define the concept and components involved in economic Analysis
- Describe the Transport Planning and Project evaluation
- Explain the method of transportation projects financing

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Tell the basic terminologies involved in economics
- Carry out economic analysis of transportation projects
- List and rank the alternatives for evaluation
- Analyse financial aspects of all highway projects

Course Contents:

Unit-1 12 hours

Highway Engineering Economics: Types, models (Kraft demand model) consumer surplus cost – cost elasticity pricing and subsidy policies, rates of interest, Vehicle operation cost, direct and indirect benefits due to road improvement, Total transportation cost, fixed and variable costs. Road user cost studies in India

Unit-2 12 hours

Economic Analysis: Various methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, Examples of economic analysis for different types of road improvement measures, pavement options, construction of bypasses and upgrading of intersections. Project priorities, methods of dealing with uncertainties.

Unit-3 12 hours

Project Evaluation: Framework of evaluation, transport planning evaluation at urban and regional levels, other evaluation procedures – achievement matrices, factor profiles, plan ranking, environmental evaluation, safety evaluation, project financing.

Unit-4 **12 hours**

Highway Finance: Financing of road projects, administration of roads, PPP models, Road safety audit, Methods of economic evaluation of highway projects

Reference Books:

- Ian G. Heggie, Transportation Engineering Economics, McGraw Hill
- Winfrey R, Highway Economic Analysis, International Textbook Company
- Road User Cost Study, Central Road Research Institute, New Delhi.
- Dickey J.W, Project Appraisal for Developing Countries, John Wiley
- L R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE2040	**CO1**			**3**		**2**				**2**		**2**	**3**	**3**	**3**	**2**
	CO2	3	3	**2**		**2**	**2**	**1**		**2**	**2**	**3**	**3**	**3**	**3**	**2**
	CO3	2	2	**3**	**3**		**2**				**3**	**3**	**3**	**3**	**3**	**1**
	CO4		3		**2**	**1**		**2**	**1**		**3**	**2**	**3**	**3**	**3**	**2**

Course code	Course Title	Duration		L	T	P	C
M18TE2051	Pavement Evaluation and Management system	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Outline the various pavement failures, causes and remedial measures
- Explain various methods of finding functional and structural condition of pavements
- Discuss the need of PMS in planning and maintaining the flexible pavements.
- Discuss the performance of pavements, causes of failure, rating methods.

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Identify the type of pavement failure, speculate its cause and decide the appropriate remedial measure
- Evaluate and determine the functional and structural condition of pavements
- Explain working of various pavement instrumentation technologies
- Develop and validate models for predicting pavement performance

Course Contents:

Unit-I 12 hours

Introduction: Structuralandfunctionalrequirements of flexibleandrigid pavements; pavementdistresses;differenttypesof pavement failures, causes and remedial measures. **Evaluation of Surface Condition:**Methods of evaluating pavement surface condition, PCI and PSI, Measurementofskid resistance and unevenness by various methods

Unit-II 12 hours

Evaluation ofPavementStructuralCondition: Evaluationby non - destructivetests such asFWD,Benkelman Beam rebounddeflectionusing BBDforflexible overlay design, Plateloadtest, Evaluationby destructivetestingmethods.

Unit-III 12 hours

Pavement Instrumentation: Role of sensors in pavement evaluation,Principle and working of Load cells, Strain gauges,Density Gauges, Temperature Gauges and Multi-depth Deflectometer. **Introduction to PMS:** Basic components of PMS, Network and Project levels of PMS, Functions of PMS

Unit-IV **12 hours**

Pavement Performance: Serviceability concepts, Modeling techniques, Structural condition deterioration models, Mechanistic and empirical models, HDM and other models, comparison of different deterioration models. **Design Alternatives and Selection:** Design objectives and constraints, Basic structural response models, Analysis of alternate pavement strategies based on distress and performance. Role of computers in PMS

Reference Books:

- Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co. 1978.
- Ralph Haas, Ronald Hudson Zanieswki. 'Modern Pavement Management, Krieger Publications, New York, 1992.
- Proceedings of North American Conference on Managing Pavement, USA, 2004.
- Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports, USA, 2006.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE2051	CO1		3	3		3							2	2		
	CO2		3		3	3						3		2		
	CO3		3	3	3	3			3			3	2	2		
	CO4															

Course code	Course Title	Duration		L	T	P	C
M18TE2052	Transportation System Management	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: Traffic Engineering

Course Learning Objectives:

- Explain the methods of data collection and analysis for traffic management
- Interpret the various transportation problems and explain solutions for effective and efficient management
- Discuss the problems associated with a site, conduct necessary surveys and arrive at feasible real world solutions

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Classify the various surveys required for traffic management
- Illustrate transportation problem at a given site
- Analyze the survey data and synthesize efficient traffic management measures
- Improvements in traffic operation

Course Contents:

Unit I **12 hours**

Methodology and Data Collection: Methodological frame work, objectives and problems, conflicts resolution, strategic categories and action elements, travel behaviour impact and response time.**TSM actions:** combinations and interactions, impact assessment and evaluation, monitoring and surveillance, Area wide data collection methodology, corridor data collection methodology.

Unit II **12 hours**

Public transportation and HOV treatment: Toll discounts for car pools during peak periods, park and ride, carpooling, exclusive lanes, priority at ramp terminals, bus transfer stations, limited and skip-stop bus services, shared ride.

Unit III **12 hours**

Traffic Operations Improvement: On-street parking ban, freeway ramp control and closure, travel on shoulders, one-way streets, reversible lanes, traffic calming, Right turn phase, right turn lanes, reroute turning traffic.

Unit IV **12 hours**

Parking Management: Short term reserved parking, increased parking rates, time duration limits, and expanded off-street parking, Non-Motorized Transport- pedestrian only streets, Dial-a-ride for elderly and handicapped.

Reference Books:

- Khisty, C. J, and Lall, B. K., Transportation Engineering: An Introduction, Prentice Hall International, Inc., 2002.
- C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI.
- Institution of Transportation Engineers, Traffic Engineering Hand Book, 4th Edition, Prentice Hall, 1999.
- Transportation System Management, State of the Art, UMTA, USDOT, 2008
- TRB Publications.
- Relevant IRC Publications.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
MTTE 15F2420	CO1		3	3		3							2	2		
	CO2		3		3	3						3		2		
	CO3		3	3	3	3			3			3	2	2		
	CO4															

Course code	Course Title	Duration		L	T	P	C
M18TE2061	Highway Construction and Maintenance	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: Highway Materials and Testing
Course Learning Objectives:

- Illustrate and classify the various Equipments for Highway material production and construction
- Outline the specifications and procedures for constructing flexible and rigid pavements
- Outline the various maintenance**,** measures and quality control tests
- Explain the method of special problems in road construction

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Explain the working of various Equipments for Highway material production and construction
- Categorize and explain various construction procedures for flexible and rigid pavements
- Decide and interpret maintenance measures for flexible and rigid pavements
- Decide suitable methods for road conditions in special areas

Course Contents:

Unit-I **12 hours**

Introduction
Components of road and pavement structure, functions, requirements and sequence of construction operations. **Equipment's for Material Production:** Crushers, Mixers, Bituminous mixing plants, Cement concrete mixers – Various types, advantages and choice. **Equipment's for Road Construction -** Different types of excavators, Graders, Soil compactors / rollers, Pavers and other equipment for construction of different pavement layers – their uses and choice.

Unit-II **12 hours**

Pre-construction surveys and marking on ground: Specifications and steps for the construction of road formation in embankment and cut, construction steps for subgrade (preparation of subgrade) in cutting, filling and at grade, Different types of granular base course, Different types of sub-base, Road maintenance works and quality control tests as per MORTH specification

Unit-III **12 hours**

Flexible Pavement Construction: Subgrade, GSB, WBM, WMM, DBM and BC – specifications and construction methods. Overview of special bituminous layers for surface courses. **Rigid Pavement Construction:** Subgrade, DLC, RCC, PQC – specifications, construction methods. Overview of special cement concrete pavements like ICBP, CRCP, FRCP, UTWT.

Unit-IV **12 hours**

Highway Maintenance Works: Types of Maintenance works, Maintenance of Gravel, WBM, WMM, Bituminous and Concrete surfaces, Maintenance of Shoulders, slopes of embankments and side drains. **Special problems** in construction and maintenance of hill roads, land slide, causes, investigation, and preventive and remedial measures, protection of embankment and cut slopes.

Reference Books:

- David and Paul Croney, "Design and performance of road pavements"- third edition, Mc Graw hill, 1998.
- Chitkara, K. K. 'Construction Project Management: Planning, Scheduling and Control', Tata Mc Graw Hill Publishing Company, New Delhi.
- Peurifoy, R.L., and Clifford, J S 'Construction Planning Equipment and Method'- McGraw Hill Book Co. Inc.
- Sharma S.C., "Construction Equipment and its Management"- Khanna Publishers
- Jotin Khisty, B Kent Lall " Transportation Engineering" PHI, 3rd edition, 2003
- Relevant IRC Publications.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE2061	CO1		2	3		3			3			3	2	2		
	CO2	2			3		3					3	3	3		
	CO3	2			3		3			3		3	3	3		
	CO4	2			3		3	3					2	3		

Course code	Course Title	Duration		L	T	P	C
M18TE2062	Planning and Management of Highway Projects	16 weeks	SC	3	1	0	5
Internal assessment: 50 Marks		Semester End Exam: 50 Marks (Minimum 20 Marks)					

Course Prerequisite: None

Course Learning Objectives:

- Explain basic construction history.
- Discuss the process for planning a new roadway pavement
- Conceptualize and draft a schedule using a bar chart to include construction and deconstruction of a project
- State the responsibilities and risks involved in the construction process.
- Describe the processes involved in earthmoving, rock excavation and road building

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Summarize the planning of new roadway
- Demonstrate practical application of construction and deconstruction of project
- Choose the right method to compel the construction process
- Analyze the costs required for a construction project

Course Contents:

Unit –I **12 hours**

Planning of Road Projects: Project frame work, scope, project objectives, project environment, causes of project failure, project development process

Unit –II **12 hours**

Resource Planning: Human resources, project man power grouping, structuring site organisation, construction materials, classification of construction materials, materials usage, materials inventory, cost and budget

Unit –III **12 hours**

Construction Equipment and Choice: Type, capacity and number, task considerations, cost considerations, engineering considerations, equipment acquisition options, optimum location of crushing and mixing plants, problems.

Unit-IV **12 hours**

Time Planning: Breakdown of project work, determining activities involved, assessment of duration, CPM/PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, Problems Planning Control System: resource production, project cost, project time, codification and project management, information system.

Reference books:

- K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling ", Tata McGraw Hill Publications
- S.C. Sharma. "Construction Equipment and its Management", Khanna Publishers
- Peurify/Schexanyder, "Construction Planning, Equipment's and Methods", Tata McGraw Hill Publications
- IRC "A Manual for the Application of Critical Path Method to Highway Projects in India"
- NHAI.org.pmgsy.nic.in website

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18 TE2062	CO1	2	2				2	2	2				1	2		
	CO2	2	2					2	2				2	2	3	
	CO3	2	2		3			3	3				1	2	3	2
	CO4		2		3	3		2	2					2	3	2

Course code	Course Title	Duration		L	T	P	C
M18TE2070	Traffic Engineering Laboratory	16 Weeks	HC	0	0	4	3
Internal assessment: 20 Marks	Semester End Exam: 30 Marks (Minimum 08 Marks)						

Course Prerequisite: Traffic Engineering

Course Learning Objectives:

- Explains the origin, properties, constituents of traffic surveys
- Provide the overview about traffic studies

Course Outcomes:

At the end of the course, the student is expected to be able to:

- Conduct all types of traffic surveys
- Conduct all types of traffic studies

Course Contents

PART-1 **12 hours**

1. Driver characteristics
2. Pedestrian studies
3. Vehicular characteristics
4. Spot speed studies
5. Speed and delay studies
6. Volume studies
7. Turning movement studies
8. Origin and destination studies
9. Parking inventory studies
10. Parking demand studies
11. Accident data collection
12. Individual accident studies
13. Traffic signage studies
14. Black spot investigations
15. General case study
16. General case study

PART-2 **12 hours**

8. Traffic flow parameters at mid-block sections

9. Traffic flow parameters at bottlenecks

10. Traffic flow parameters at toll booths

11. Vehicle arrivals – gap distribution

12. Vehicle arrivals – counting distribution

13. Gap acceptance – case study

14. Delays at uncontrolled intersections

15. Delays at signalised intersections

16. Capacity determination of rural highway - case study

17. Capacity determination of urban arterial - case study

18. Capacity determination of signalised intersection - case study

19. Capacity determination of weaving section - case study

20. Study and evaluation of at-grade intersection – case study

21. Study and evaluation of grade separated intersection – case study

22. Traffic simulation

and Modifiers in Bituminous mixes –

Reference Books:

- Relevant IRC and IS code Books.
- MoRTH 'Specifications for Roads and Bridges Works'- Indian Roads Congress
- Khanna and Justo, "Highway Engineering"- Nem Chand and Bros., Roorkee

Mapping of Po's and Co's

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
M18TE2070	CO1	3	3	3	3	3	3						3		3	
	CO2	2	3	3	3							3	3	3	3	1
	CO3	3	2	1	3	1	3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	1	3

M18TE3010	ROADS AND BUILDING STRUCTURES	L	T	P	C	Hrs.
Duration:16weeks		3	1	0	4	5
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)					

COURSE OBJECTIVE: Student will be able to learn

1. About traffic characteristics and control over the vehicles.
2. The importance of highway geometric design and drainage systems.
3. Understand the building planning and Bye-Laws.
4. Different aspects of building construction.

COURSE OUTCOME: After successful completion of this course thestudent will be able to:

1: Describe about traffic characteristics and control over the vehicles.
2: Provide conceptual details of highway geometric design and drainage systems
3: Describe building planning and Bye-Laws.
4: Provide different aspects of building construction.

UNIT-I	12HOURS

Traffic Characteristics: Objectives and scope of traffic engineering. Components of road traffic: the vehicle, driver and road. Road user characteristics: human and vehicular characteristics.

Traffic Regulation and Control: Driver, vehicle, traffic flow and general regulations and control. Traffic Control Devices: traffic signs, markings, islands and signals.

UNIT-II	12HOURS

Elements of Highway Geometric Design: Design controls and criteria. Cross Section Elements: Pavement surface characteristics, width considerations for various components of cross section elements, right of way.

Highway Drainage: Objects and requirements of highway drainage. Surface drainage systems – analysis and design. Sub-surface drainage systems types and design.

UNIT-III	12HOURS

Building Planning: Introduction, Types of Buildings Based on Occupancy, Types of Residential Buildings, Basic Concepts of Building Elements,Methods of Construction,Cost-effective Building Techniques in Construction,Construction Management Techniques, Site Selection for Residential Buildings, Influence of Climate on Building Planning, Orientation of Building , Principles of Building Planning , Building bye-Laws , Planning of Residential Buildings, Building Services .

UNIT-IV	12HOURS

Building Construction: Foundations, Shallow and Deep Foundations, Stone Masonry, Brick Masonry,Partitions,Lintels, Stairs, Doors, Windows And Ventilators,Floors And Flooring , Roofs, Pointing And Plastering , Painting, Varnishing And Distempering, Etc. Acoustics, Fire Protection in Buildings.

REFERENCE

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee - 2014.
2. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publishers, Delhi – 2007.
3. Relevant IRC Publications.
4. "Building Drawing", Shah M.H and Kale C.M, Tata McGraw Hill Publishing co. Ltd., New Delhi.
5. "Building Construction", Gurucharan Singh, Standard Publishers &distributors, New Delhi.
6. National Building Code, BIS, New Delhi.

Mapping of Po's and Co's

Course Code	POS / COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	PSO 1	PSO 2	PSO 3	PSO 4
M18TE3010	CO1	2	3		1		2		1	1			3			
	CO2	3	2		2	2	2	3		2			3		1	2
	CO3	3	3	2	2		1			2	1		3	3	3	2
	CO4	3					3	3	2	2			3			