

Ramgarhia Polytechnic College, Phagwara



Civil Engineering Department

Head of Department:	Er. Gurcharan Singh
Name of the Faculty:	Er. Rahul verma
Discipline:	Civil Engineering Department
Semester:	5 th
Subject:	Highway Engineering
Lesson Plan Duration:	16 Weeks





















RATIONALE

Construction of roads is one of the major areas in which diploma holders in Civil Engineering may get very good opportunities for employment. The diploma holders are responsible for construction and maintenance of highways and airports. Basic concepts of road geo-metrics, surveys and plans, elements of traffic engineering, road materials, construction of rigid and flexible pavements, special features of hill roads, road drainage system and various aspects of maintenance find place in above course.

Learning Outcomes

After undergoing the subject, students will be able to:

- CO1. Classify the roads as per IRC types and geometrics
- CO2. Explain various components of a flexible/rigid pavement
- CO3. Select various highway materials and test them for different quality parameters
- CO4. Supervise construction of a highway in plain areas and hilly areas
- CO5. Carry out repair and maintenance of roads
- CO6. Supervise preparation of bituminous mix in the hot mix plants
- CO7. Use various road construction equipment
- CO8. Describe the basic terminology of various components of an airport.

PO 	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 							
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							
CO7							
CO8							

Syllabus

Units	Details	Hours
1.	<p>1. Introduction</p> <p>1.1 Importance of Highway engineering</p> <p>1.2 Functions of IRC, CRRI, MORT&H, NHAI</p> <p>1.3 Classification of roads</p>	(2 hrs)
2.	<p>. Road Geometrics</p> <p>2.1 Glossary of terms used in road geo-metrics and their importance: Right of way, formation width, road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradient</p> <p>2.2 Average running speed, stopping and overtaking sight distance 145</p> <p>2.3 Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation</p> <p>2.4 Sketch of typical cross-sections in cutting and filling on straight alignment and at a curve</p>	(10 hrs)
3.	<p>Highway Alignment</p> <p>3.1 Basic considerations governing alignment for a road in plain and hilly area</p> <p>3.2 Highway location, marking of alignment on ground, setting out alignment of road, setting out bench marks, control pegs for embankment and cutting</p>	(10 hrs)
4.	<p>Road Materials</p> <p>4.1 Different types of road materials in use; soil, aggregate and binders</p> <p>4.2 Introduction to California Bearing Ratio, method of finding CBR value and its significance. Aggregate : Source and types, important properties, strength, durability</p> <p>4.3 Binders: Common binders; bitumen, properties as per BIS specifications, penetration, softening point, ductility and viscosity test of bitumen, procedures and significance, cut back and emulsion and their uses, Bitumen modifiers (CRMB, PMB)</p>	(10 hrs)

5.	<p>Road Pavements</p> <p>5.1 Road pavement: Flexible and rigid pavement, their merits and demerits, typical cross-sections, functions of various components</p> <p>5.2 Sub-grade preparation: Borrow pits, making profiles of embankment, construction of embankment, compaction, preparation of subgrade, methods of checking camber, gradient and alignment as per recommendations of IRC, equipment used for subgrade preparation.</p> <p>5.3 Stabilization of subgrade. Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc.(introduction only)</p> <p>5.4 Base Course:</p> <p>Granular base course: (a) Water Bound Macadam (WBM) (b) Wet Mix Macadam (WMM) 146</p> <p>Bitumen Courses: (a) Bituminous Macadam (b) Dense Bituminous Macadam (DBM) *Methods of construction as per MORT&H</p> <p>5.5 Surfacing: * Types of surfacing a) Prime coat and tack coat b) Surface dressing with seal coat c) Open graded premix carpet d) Mix seal surfacing</p> <p>e) Semi dense bituminous concrete f) Bituminous Concrete</p> <p>* Methods of constructions as per MORT&H specifications and quality control; equipments used for above.</p> <p>5.6 Rigid Pavements: Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete, compacting and finishing, curing, joints in concrete pavement, equipment used. Roller compacted concrete.</p>	(12 hrs)
6.	Hill Roads:	(06 hrs)

	6.1 Introduction: Typical cross-sections showing all details of a typical hill road, partly in cutting and partly in filling 6.2 Special problems of hill areas 6.2.1 Landslides: Causes, prevention and control measures, use of geogrids, geoflexbiles, geo synthetics 6.2.2 Drainage 6.2.3 Soil erosion 6.2.4 Snow: Snow clearance, snow avalanches, frost 6.2.5 Land Subsidence	
7.	Road Drainage: 7.1 Necessity of road drainage work, cross drainage works 7.2 Surface and subsurface drains and storm water drains. Location, spacing and typical details of side drains, side ditches for surface drainage. Intercepting drains, pipe drains in hill roads, details of drains in cutting embankment, typical cross sections	(6 hrs)
8	Road Maintenance: 8.1 Common types of road failures of flexible pavements: Pot hole, cracks, rutting, alligator, cracking, upheaval - their causes and remedies (brief description) 8.2 Maintenance of bituminous road such as crack sealing, patch-work and resurfacing. 8.3 Maintenance of concrete roads-filling cracks, repairing joints, maintenance of shoulders (berms)	(6hrs)
9	Road Construction Equipment: (08 hrs) Output and use of the following plant and equipment 9.1 Hot mix plant 9.2 Tipper, tractors (wheel and crawler) scraper, bulldozer, dumpers, shovels, grader, roller, dragline 9.3 Asphalt mixer and tar boilers 9.4 Road pavers	(8 hrs)
10	Airport Engineering :- (10 hrs) 10.1 Necessity of study of airport engineering, aviation transport scenario in India. 10.2 Factors to be considered while selecting a site for an airport with respect to zoning laws. 10.3 Introduction to Runways, Taxiways, Apron and Hanger	(10 hrs)

Reference Books:

- i) Khanna, SK and Justo, CEG, "Highway Engineering", Nem Chand and Bros., Roorkee
- ii) Vaswani, NK, "Highway Engineering", Roorkee Publishing House, Roorkee,
- iii) Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall
- iv) Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" S Chand and Co, Delhi
- v) Bindra, SP; "A Course on Highway Engineering", Dhanpat Rai and Sons, New Delhi
- vi) Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", Asia Publishing House, New Delhi
- vii) Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", New Age Publishers (P) Ltd, Delhi,
- viii) NITTTR, Chandigarh "Laboratory Manual in Highway Engineering",
- ix) RK Khitoliya, "Principles of Highway Engineering (2005)", Dhanpat Rai Publishing Co., New Delhi
- x) Rao, GV' Transportation Engineering
- xi) Duggal AK, "Maintenance of Highway – a Reader", NITTTR, Chandigarh
- xii) Duggal AK "Types of Highway constitution ", NITTTR Chandigarh
- xiii) Rao, "Airport Engineering"
- xiv) Singh, Jagroop, "Highway Engineering", Eagle Publications, Jalandhar

Delivery/Instructional Methodologies

Sr.No.	Description
1.	Chalk and Talk
2.	PowerPoint Presentation

Assessment Methodologies

Sr. No.	Description	Type
1.	Student Assignment	Direct
2.	Test	Direct

3.	Board Examination	Direct
4.	Student Feedback	Direct

Gaps in the syllabus - to meet industry/profession requirements

S.NO.	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
	N/A	N/A	N/A

Topics beyond syllabus/advanced topics

Units	Details	Hours
N/A	N/A	N/A

Web Source References

Sr. No.	URL
1.	https://nptel.ac.in/

Lesson Plan

Week	Theory		Practical	
	Lecture Day		Practical Day	

1 st	1 st	Importance of Highway engineering Functions of IRC, CRRI, MORT&H, NHAI	1.	Determination of penetration value of bitumen
	2 nd	Classification of roads		
	3 rd	Glossary of terms used in road geo-metrics and their importance: Right of way, formation width		
	4 th	Road margin, road shoulder, carriage way, side slopes		
	5 th	kerbs, formation levels, camber		
2 nd	6 th	Gradient	2.	Determination of softening point of bitumen
	7 th	Average running speed, stopping		
	8 th	Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation		
	9 th	Super elevation and methods of providing super elevation		
	10 th	Sketch of typical cross-sections in cutting and filling on straight alignment and at a curve		
3 rd	11 th	Super elevation and methods of providing super elevation	3.	Determination of ductility of bitumen
	12 th	Overtaking sight distance		
	13 th	Highway Alignment		
	14 th	Basic considerations governing alignment for a		

		road in plain and hilly area		
	15 th	Introduction to Highway location		
4 th	16 th	Highway location	4.	Determination of impact value of the road aggregate
	17 th	Setting out alignment of road		
	18 th	Setting out bench marks		
	19 th	Control pegs for embankment and cutting		
	20 th	Control pegs for embankment and cutting		
5 th	21 st	Marking of alignment on ground	5.	Determination of abrasion value (Los Angeles') of road aggregate
	22 nd	Marking of alignment on ground		
	23 rd	Road Materials		
	24 th	Different types of road materials in use		
	25 th	soil, aggregate and binders		
6 th	26 th	Introduction to California Bearing Ratio	6.	Determination of crushing strength of aggregate
	27 th	method of finding CBR value and its significance		
	28 th	Aggregate : Source and types, important properties, strength, durability		
	29 th	Binders: Common binders; bitumen		
	30 th	properties as per BIS specifications		
7 th	31 st	penetration, softening point, ductility and viscosity test of bitumen,		Determination of flakness and

		procedures and significance	7.	elongation index of aggregate
	32 nd	Cut back and emulsion and their uses, Bitumen modifiers (CRMB, PMB		
	33 rd	Road Pavements		
	34 th	Road pavement: Flexible and rigid pavement, their merits and demerits		
	35 th	Typical cross-sections, functions of various components		
8 th	36 th	Sub-grade preparation: Borrow pits, making profiles of embankment, construction of embankment	8.	Determination of the California bearing ratio (CBR) for the sub-grade soil
	37 th	Compaction, preparation of subgrade, methods of checking camber		
	38 th	Gradient and alignment as per recommendations of IRC		
	39 th	Equipment used for subgrade preparation.		
	40 th	Stabilization of subgrade Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc.(introduction only)		
9 th	41 st	Base Course: Granular base course: (a) Water Bound Macadam (WBM) (b) Wet Mix Macadam (WMM) Bitumen Courses: (a) Bituminous Macadam (b) Dense Bituminous Macadam (DBM) *Methods of construction as per MORT&H	9.	Demonstration of working of hot mix plant through a field visit
	42 nd	Surfacing: * Types of surfacing a) Prime coat		

		and tack coat b) Surface dressing with seal coat c) Open graded premix carpet d) Mix seal surfacing e) Semi dense bituminous concrete f) Bituminous Concrete * Methods of constructions as per MORT&H specifications and quality control; equipments used for above.		
	43 rd	Rigid Pavements: Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete,		
	44 th	Compacting and finishing, curing, joints in concrete pavement, equipment used. Roller compacted concrete.		
	45 th	Hill Roads		
10 th	46 th	Introduction: Typical cross-sections showing all details of a typical hill road	10.	Visit to highway construction site for demonstration of operation of: Tipper, tractors (wheel and crawler), scraper, bulldozer, dumpers, shovels, grader, roller, dragline, road pavers, JCB
	47 th	Partly in cutting and partly in filling		
	48 th	Special problems of hill areas , Landslides: Causes, prevention and control measures		
	49 th	<u>Use</u> of geogrids, geoflexbiles, geo synthetics		
	50 th	Drainage , Soil erosion ,Snow: Snow clearance, snow avalanches, frost Land Subsidence		
	51 st	Road Drainage		Demonstration of working of mixing and

11 th	52 nd	Necessity of road drainage work, cross drainage works	11	spraying equipment through a field visit
	53 rd	Surface and subsurface drains and storm water drains. Location		
	54 th	Spacing and typical details of side drains		
	55 th	Side ditches for surface drainage		
12 th	56 th	Intercepting drains, pipe drains in hill roads, details of drains in cutting embankment, typical cross sections	12.	Determination of impact value of the road aggregate
	57 th	Road Maintenance		
	58 th	Common types of road failures of flexible pavements: Pot hole, cracks		
	59 th	Rutting, alligator, cracking, upheaval - their causes and remedies (brief description)		
	60 th	Maintenance of bituminous road such as crack sealing, patch-work and resurfacing		
13 th	61 st	Maintenance of concrete roads-filling cracks	13.	Determination of softening point of bitumen
	62 nd	Repairing joints, maintenance of shoulders (berms)		
	63 rd	Road Construction Equipment		
	64 th	Output and use of the following plant and equipment		
	65 th	Hot mix plant , Tipper, tractors (wheel and crawler) scraper		

14 th	66 th	Bulldozer, dumpers, shovels, grader, roller, dragline	14.	Determination of softening point of bitumen
	67 th	Asphalt mixer and tar boilers		
	68 th	Road pavers		
	69 th	Airport Engineering		
	70 th	Necessity of study of airport engineering		
15 th	71 st	Factors to be considered while selecting a site for an airport with respect to zoning laws.	15.	Determination of penetration value of bitumen
	72 nd	Factors to be considered while selecting a site for an airport with respect to zoning laws.		
	73 rd	Apron and Hanger		
	74 th	Apron and Hanger		
	75 th	Introduction to Runways, Taxiways		
16 th	76 th	Introduction to Runways, Taxiways		Determination of the California bearing ratio

	77 th	Aviation transport scenario in India.	16.	(CBR) for the sub-grade soil
	78 th	Rutting, alligator, cracking, upheaval - their causes and remedies (brief description)		
	79 th	Rigid Pavements: Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete		
	80 th	Stabilization of subgrade Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc.(introduction only)		

NBA has defined the following seven POs for an Engineering diploma graduate:

- i) **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
- ii) **Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
- iii) **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
- iv) **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

- v) **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- vi) **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- vii) **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes.

Program Specific Outcomes (PSOs)

PSOs are a statement that describes what students are expected to know and be able to do in a specialized area of discipline upon graduation from a program. Program may specify 2-4 program specific outcomes, if required.

These are the statements, which are specific to the particular 11 program. They are beyond POs. Program Curriculum and other activities during the program must help in the achievement of PSOs along with POs.