



**YESHWANTRAO CHAVAN COLLEGE OF ENGINEERING**  
(An Autonomous Institution affiliated to R T M Nagpur University Nagpur)  
Accredited by NAAC (1<sup>st</sup> Cycle) with 'A' Grade (Score 3.25 on 4 Point Scale)

Wanadongri, Hingna Road, Nagpur-441110

## **Department of Civil Engineering (Honors in CT)**



**B.E. Honors in Construction Technology  
SoE & Syllabus 2021-22**



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

**Department of Civil Engineering**

**SoE and Syllabus**

**B.E Honors in Construction Technology**

**SoE No.  
HON-101**

## Information Brochure of Honor Program

1. Title of Program: **B.E Honors in Construction Technology**
2. Type of Program : **Honor**
3. Department offering the program: **Civil Engineering on SWAYAM/NPTEL**
4. Students of Department of Civil Engineering are only eligible to opt for this program.
5. General information about courses in program:

Whether it's residential, commercial, or industrial, the construction process is complex and requires an incredible collaboration of numerous professionals at every stage of development. From planning, development, and financing right through until project completion, there are many elements at stake. A wide variety of roles and responsibilities are required to successfully complete any size project, making the entire construction process an impressive feat of technical engineering, design, and human orchestration. Those who work in the construction field take pride in being involved in projects that begin simply as an idea and result in a building that is a tangible and productive output that will have a positive impact for years to come. Construction projects of any size are an art and a science that bring together the systematic organization of many skills, talents, manufactured supplies, and technologies to produce a particular structure for an ongoing purpose. Because construction standards and codes vary from region to region, meticulous dedication and commitment to regulations are required throughout the entire process. A devotion to planning and proper execution is crucial in all forms of construction.

Construction technology refers to the collection of innovative tools, machinery, modifications, software, etc. used during the construction phase of a project that enables advancement in field construction methods, including semi-automated and automated construction equipment. The program which includes the courses like Construction Methods and Equipment Management, Characterization of Construction Materials, Principles of Construction Management, Safety in Construction, Modern Construction Materials and Development and Applications of Special Concretes is all set to cater the needs of construction industry

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



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**Department of Civil Engineering**

**SoE and Syllabus**

**B.E Honors in Construction Technology**



**SoE No.  
HON-101**

## 6. Advance knowledge or research orientation of Program:

The construction industry is repeatedly criticized for being inefficient and slow to innovate. The basic methods of construction, techniques and technologies have changed little since Roman times. But the application of innovation in the construction industry is not straight forward. Every construction project is different, every site is a singular prototype, construction works are located in different places, and involve the constant movement of personnel and machinery. In addition, the weather and other factors can prevent the application of previous experience effectively. The term 'construction technology' covers a wide range of modern techniques and practices that encompass the latest developments in materials technology, design procedures, quantity surveying, facilities management, services, structural analysis and design, and management studies. Incorporating advanced construction technology into practice can increase levels of quality, efficiency, safety, sustainability and value for money. However, there is often a conflict between traditional industry methods and innovative new practices, and this is often blamed for the relatively slow rate of technology transfer within the industry. The adoption of advanced construction technology requires an appropriate design, commitment from the whole project team, suitable procurement strategies, good quality control, appropriate training and careful commissioning.

## 7. Employability potential of program:

A career in construction technology is an engaging and rewarding pursuit for workers with the right attitude and ambition. Fortunately, the growing demand for employees in the field of construction technology means there are more opportunities now than ever before to obtain an education and enter the field in the area of your choice. From the initial planning to the actual construction process, there are many careers associated with improving the industry. Some of the main jobs associated with construction technology are construction managers, project managers, building inspectors, cost estimators, architects, civil engineers, However, a lot of these jobs require certain education requirements. The construction sector is one of the fastest-changing sectors for employment in today's marketplace. With an increasing demand for higher efficiency, energy savings, and building innovation, this industry is ideal for employees who want a challenging and dynamic career with plenty of growth opportunities. Construction

		May 2021	1.00	Applicable for AY2021-22 Onwards
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# Yeshwantrao Chavan College of Engineering

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## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

practices are constantly changing in order to apply today's latest technology and to meet the growing demand for land development, residential and commercial building, and infrastructure enhancements. Although the industry is growing, there are not enough qualified workers in the field to keep up. Today's world of construction has evolved dramatically since the industrial revolution as our general concern regarding environmental impact and waste has shifted. With growing awareness of the waste that is typically produced during a construction project of any size, new opportunities for innovative technologies and practices are also evolving, creating new space for different career paths in this industry.

#### 8. Departmental Steering committee:

S N	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Dr. V.G. Meshram	Chairman	Associate Professor & Head	hod_ce@ycce.edu	9850340838
2	Dr. S.R. Khandeshwar	Member	Professor	khandeshwar333@yahoo.com	9822578533
3	Dr. S.V. Ambekar	Member	Professor	sv_ambekar@rediffmail.com	9422105597
4	Dr. A.R Gajbhiye	Member	Professor	yccehodcivil@yahoo.in	9850958980

#### 9. Departmental Steering committee:

S N	Name of the Faculty Member	Post	Designation	e-mail ID	Contact Number
1	Dr. Ms. M.S. Bhagat	Co-Ordinator	Assistant Professor	msbciv2gmail.com	7620494011

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

### Scheme of Examinations

B.E Honors in (Construction Technology) NPTEL													
SN	Sem	Sub Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA	ESE	
1	V	CVHN01	Construction Methods and Equipment Management	T					3	This is SWAYAM / NPTEL based program and subjects with 12–14-week syllabus is expected to be available on SWAYAM/NPTEL platform.  If they are not available before the commencement of semester, Similar / Equivalent Subjects shall be notified by BoS of the Department.  Chairman BoS will notify all the subjects which are 12-14 week duration before the commencement of academic session.			
2	V	CVHN02	Characterization of Construction Materials	T					3				
3	VI	CVHN11	Principles of Construction Management	T					3				
4	VI	CVHN12	Safety in Construction	T					3				
5	VII	CVHN21	Modern Construction Materials	T					3				
6	VII	CVHN22	Development and Applications of Special Concretes	T					3				
<b>TOTAL</b>									<b>18</b>				

MSEs\* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

TA \*\* = for Theory : 20 marks on lecture quizzes, 8 marks on assignments, 2 marks on class performance

TA\*\* = for Practical : MSPA will be 15 marks each

		May 2021	1.00	Applicable for AY2021-22 Onwards
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Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Civil Engineering

SoE and Syllabus

**B.E Honors in Construction Technology**

SoE No.  
HON-101

## V Semester

CVHN01	Construction Methods and Equipment Management			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to <ol style="list-style-type: none"><li>To study about equipment selection</li><li>To know about optimum replacement time of equipment.</li><li>To understand about cost estimation.</li><li>To study about pile driving equipment.</li></ol>	Students should be able to <ol style="list-style-type: none"><li>An ability to provide comprehensive information on guidelines for selection of equipment, estimation of cost and productivity of various equipment.</li><li>An ability to determine optimum replacement time of equipment.</li><li>An ability to apply knowledge on estimation of cost of equipment.</li><li>An ability to understand excavation, pile driving methods, cranes and concreting equipment.</li></ol>
<b>Mapped Program Outcomes : 1,5,6,7,8,9,11</b>	

<b>UNIT-1 :</b> Introduction to course and Planning Process for Equipment: Equipment selection, utilization and replacement. Estimation of ownership cost : Average Annual Investment method	[07 Hrs.]
<b>UNIT-2 :</b> Cost of Owning and Operating Construction Equipment Estimation of ownership cost: Time value method, operating cost of equipment, equipment cost estimation.	[06 Hrs.]
<b>UNIT-3 :</b> Equipment Life and Replacement Analysis Ways of defining equipment life : Purchase, use and replacement, Illustration on determination of economic life of equipment.	[07 Hrs.]
<b>UNIT-4 :</b> Engineering fundamentals of moving earth: Bull dozers, scrapers, Earthmoving and Excavating equipment: Front end loaders, excavators, trucks.	[06 Hrs.]
<b>UNIT-5 :</b> Piles and Pile driving equipment: types of pile hammers, guidelines for selection of pile hammers, classification of pile, principle of pile hammer, factors governing selection of pile hammer.	[07 Hrs.]

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Civil Engineering

SoE and Syllabus

**B.E Honors in Construction Technology**

SoE No.  
HON-101

**UNIT-6 : Lifting Equipment: cranes, Concreting Equipment, Tunnel boring machine.**

**[06 Hrs.]**

### Text Books:

	Title	Edition	Author	Publisher
1	Heavy construction: Planning, equipment & method	2 <sup>nd</sup> edition	Singh J	Taylor and Francis
2	Construction material, method & techniques		Spence, W.P.	Delmar publisher
3	Quantitative techniques in management		Vohra, N.D	Tata McGraw- hill educations
4	Construction planning, Equipment & method		R.L. Peurifoy	Tata McGraw- hill educations

### Reference Book:

	Title	Edition	Author	Publisher
1	Construction equipment guide	2 <sup>nd</sup> Edition	Day D.A., & Benjamin, N.B.H	John wiley & sons
2	Modern construction and ground engineering equipment	2 <sup>nd</sup> edition	Harris, F	Pearson Lonfman
3	Construction equipment management for engineers, estimators & owners	2 <sup>nd</sup> edition	Gransberg, D.P., Prospescu, CM, & Ryan R.C	CRC press.
4	Construction methods & management	2 <sup>nd</sup> edition	Nunnally, S.W	Prentice Hall

		May 2021	1.00	Applicable for AY2021-22 Onwards
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(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

#### V Semester

CVHN02	Characterization of Construction Materials			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to <ol style="list-style-type: none"> <li>To understand the basic concepts of characterization of construction materials.</li> <li>Understand To develop systematic knowledge of different constituents of material.</li> </ol>	Students should be able to <ol style="list-style-type: none"> <li>Understand the basic fundamentals of need of characterization of construction material.</li> <li>Apply the various characterization techniques.</li> <li>Evaluate the Physico-chemical properties of construction material using characterization techniques.</li> </ol>
<b>Mapped Program Outcomes : 5,6,7,8,9,11</b>	

<b>UNIT-1:</b> Introduction to Characterization of Construction Materials and Structure of Construction Materials, Introduction and types of Calorimeters, Sample preparation, Practical note and Heat of hydration, Applications of calorimeter.	[06 Hrs.]
<b>UNIT-2</b> Introduction to X Rays and crystallography, Crystal systems and History of XRD, Diffractogram & its Calculations, Qualitative Phase Analysis, Sample Preparation and Application in study of cements.	[07 Hrs.]
<b>UNIT-3</b> :Introduction to Thermal Analysis, Application of thermal analysis to study construction materials Surface Area Measurement: Sampling and particle size distribution, Different techniques, calculation and applications.	[06 Hrs.]
<b>UNIT-4:</b> Optical and Scanning Microscopy- Introduction and specimen preparation, Features and functions, Types of optical microscopy. Introduction to Scanning electron microscope its Parts and Functioning, Working Principles, Analysis of cementitious systems.	[07 Hrs.]
<b>UNIT-5:</b> Application of characterization techniques to assess composite binder with limestone-calcined clay, Image analysis Introduction and image mapping, Basic operations. Introduction to Spectroscopy Techniques.	[06 Hrs.]
<b>UNIT-6:</b> Introduction to Porosity and pore structure, significance of pore distribution, Working of mercury intrusion porosimeter. Electrical Impedance analysis - Principle and different methods, Deliverables and Interpretation, Electrochemical testing (Corrosion) using Electrochemical Impedance Spectroscopy (EIS).	[07 Hrs.]

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	





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# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Civil Engineering

SoE and Syllabus

**B.E Honors in Construction Technology**

SoE No.  
HON-101

### Text Books:

	Title	Edition	Author	Publisher
1	A Practical Guide to Microstructural Analysis of Cementitious Materials		Karen Scrivener, Ruben Snellings, Barbara Lautenbach	CRC Press
2	Handbook of Analytical Techniques in Concrete Science and Technology		V.S. Ramachandran and James J. Beaudoin, Eds	William Andrew Inc. New York
3	A Handbook of Investigative Techniques		D. St John, A. Poole , I. Sims	London

### Reference Book:

	Title	Edition	Author	Publisher
1	Materials Science and Engineering	9 <sup>th</sup> Edition	<u>William D. Callister Jr., David G. Rethwisch</u>	John Wiley

		May 2021	1.00	Applicable for AY2021-22 Onwards
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(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

#### VI Semester

CVHN11	Principles of Construction Management			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to <ol style="list-style-type: none"> <li>To study about project organization.</li> <li>To know about construction management.</li> <li>To understand planning and scheduling</li> <li>To study about aspects of construction project.</li> </ol>	Students should be able to <ol style="list-style-type: none"> <li>An ability to present a rounded view of the diverse issues involved in the management of construction projects.</li> <li>An ability to understand the aspects like construction economics, quality and safety management, and contract management.</li> <li>An ability to understand time management and scheduling, estimation.</li> <li>An ability to introduce about legal aspects of a construction project.</li> </ol>
<b>Mapped Program Outcomes: 5,6,7,8,9,11</b>	

<b>UNIT-1 :</b> General overview and project organization: interdisciplinary nature of modern construction projects, steps involve in execution of project, evaluation of bids based on different schemes, resource management in construction projects, PMI guidelines.	[07 Hrs.]
<b>UNIT-2 :</b> Estimation of project cost: Estimating quantities, description of items, and estimation of project cost.	[06 Hrs.]
<b>UNIT-3 :</b> Construction Economics: case study of boundary wall, running account bills, economic decision making in construction projects, depreciation of construction equipment.	[07 Hrs.]
<b>UNIT-4 :</b> Planning and scheduling: repayment of a loan, project scheduling, PERT in scheduling, project monitoring and control system, Resource levelling and allocation, crashing of networks.	[06 Hrs.]

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

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## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

<b>UNIT-5 :</b> Safety Management: accidents in construction industry, personal protective environment, implications of construction accidents, safety organizations and safety officer. Quality management: quality control in construction, epoxy coated bars, quality control of grout in ducts of post- tensioned PC members, quality control issues in concrete.	[07 Hrs.]
<b>UNIT-6 :</b> Legal aspects of a construction project: legal issues in construction management, essentials of goods contract, dispute resolution in construction projects, Types of construction contracts, closing the discussion on legal aspects, quality control at concrete sewer pipeline.	[06 Hrs.]

#### Text Books:

	Title	Edition	Author	Publisher
1	Finance for engineers- Evaluation & Funding of capital projects		Crundwell. F.K	
2	PERT & CPM –Principles & applications	3 <sup>rd</sup> edition	Srinath L.S.	

#### Reference Book:

	Title	Edition	Author	Publisher
1	Construction Project management- Theory & practice	2 <sup>nd</sup> edition	Jha K.N	Pearson India education services Pvt.ltd
2	Project management – A systems approach to planning, scheduling & controlling	10 <sup>th</sup> edition	Kerzner H	John wiley & sons

		May 2021	1.00	Applicable for AY2021-22 Onwards
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Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## Department of Civil Engineering

### SoE and Syllabus

### B.E Honors in Construction Technology

SoE No.  
HON-101

#### VI Semester

CVHN12	Safety in Construction			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to <ol style="list-style-type: none"> <li>To familiarize with the latest safety regulations.</li> <li>To introduce Indian standard applications.</li> <li>To understand management of hazardous construction project sites.</li> </ol>	Students should be able to <ol style="list-style-type: none"> <li>An ability to understand latest safety and health regulations.</li> <li>An ability to apply Indian Standards application to the construction industry.</li> <li>An ability to plan, access, analyzes and manages the hazardous construction project sites.</li> </ol>
<b>Mapped Program Outcomes : 5,6,7,8,9,11</b>	

<b>UNIT-1 :</b> Basic terminology in safety, safety standards and signs, signals in construction, role of stakeholders in construction safety.	[07 Hrs.]
<b>UNIT-2 :</b> Accident patterns, theories of accident-causation, cost of injury vs investment in safety, types of injuries, safety program accident / incident investigation, safety pyramid, PPE in construction, a case study on construction safety.	[06 Hrs.]
<b>UNIT-3 :</b> Planning for safety budget, safety culture	[07 Hrs.]
<b>UNIT-4 :</b> Introduction to OSHA regulations; Role of stakeholders in safety Site safety programs - Job hazard analysis,HIRA(Hazard identification and risk assessment),accident investigation & accident indices-violation,Penalty	[06 Hrs.]
<b>UNIT-5 :</b> Safety during construction, alteration, demolition works - Earthwork, steel construction, temporary structures, masonry & concrete construction, cutting & welding	[07 Hrs.]
<b>UNIT-6 :</b> SoPs (Safe Operating Procedures) - Construction equipment, materials handling-disposal & hand tools, Other hazards - fire, confined spaces, electrical safety; BIM & safety	[06 Hrs.]

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

**Department of Civil Engineering**

**SoE and Syllabus**

**B.E Honors in Construction Technology**

**SoE No.  
HON-101**

### Text Books:

	Title	Edition	Author	Publisher
1	Signs, signals & barricades		OSHA Subpart G,	

### Reference Book:

	Title	Edition	Author	Publisher
1	IS 9457:1980 Code of practice for safety colors and safety signs:			
2	IS 13415:1992 protective barriers in and around building – code of safety.			

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Department of Civil Engineering

SoE and Syllabus

**B.E Honors in Construction Technology**

SoE No.  
HON-101

## VII Semester

CVHN21	Modern Construction Materials			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to 1. To provide the scientific basis for understanding and developments of construction materials. 2. To give an overview of the fundamental needed to understand material structure and behaviour. 3. To discuss the important materials used today in construction.	Students should be able to 1. <b>Explain</b> various developments and materials used in construction activity. 2. <b>Study</b> different fundamental of material and behaviour. 3. <b>Apply</b> different materials and techniques used in construction.
<b>Mapped Program Outcomes : 5,7,8,9,11</b>	

<b>UNIT-1: Introduction to Science, Engineering and Technology of Materials.</b>	<b>[07 Hrs.]</b>
<b>UNIT-2: Microstructure:</b> Atomic Bonding, Atomic Bonding, Movement of Atoms & Development of Microstructure.	<b>[06 Hrs.]</b>
<b>UNIT-3: Material Behaviour:</b> Surface Properties, Response to Stress, Failure Theories, Fracture Mechanics, Rheology, Thermal Properties.	<b>[07 Hrs.]</b>
<b>UNIT-4: Structural Materials:</b> Construction Materials and Criteria for Selection, Wood and Wood Products, Polymers, Fibre Reinforced Polymers, Metals, Bituminous Materials, Concrete, Glass.	<b>[06 Hrs.]</b>
<b>UNIT-5: Non-structural materials, accessories and finishes:</b> Materials and Criteria for Selection, Waterproofing materials, Polymer Floor Finishes, Paints, Tiles, Acoustic Treatment, Dry walls, Anchors.	<b>[07 Hrs.]</b>
<b>UNIT-6: Introduction to Environmental Concerns, Social Perception of Construction Materials.</b>	<b>[06 Hrs.]</b>

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



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# Yeshwantrao Chavan College of Engineering

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**Department of Civil Engineering**

**SoE and Syllabus**

**B.E Honors in Construction Technology**

**SoE No.  
HON-101**

**Text Books:**

	<b>Title</b>	<b>Edition</b>	<b>Author</b>	<b>Publisher</b>
<b>1</b>	Building Materials		P.C. Varghese	Prentice-Hall India

**Reference Book:**

	<b>Title</b>	<b>Edition</b>	<b>Author</b>	<b>Publisher</b>
<b>1</b>	Materials Science and Engineering: An introduction		W.D. Callister	John Wiley
<b>2</b>	Materials Science and Engineering		V. Raghavan	Prentice Hall
<b>3</b>	Properties of Engineering Materials		R.A. Higgins	Industrial Press
<b>4</b>	Construction materials: Their nature and behaviour	3rd ed	Eds. J.M. Illston and P.L.J. Domone	Spon Press
<b>5</b>	The Science and Technology of Civil Engineering Materials		J.F. Young, S. Mindess, R.J. Gray & A. Bentur	Prentice Hall
<b>6</b>	Concrete: Microstructure, properties and materials		P.K. Mehta and P.J.M. Monteiro	McGraw Hill
<b>7</b>	Properties of concrete		A.M. Neville	Pearson

		May 2021	1.00	Applicable for AY2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	



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# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

**Department of Civil Engineering****SoE and Syllabus****B.E Honors in Construction Technology****SoE No.  
HON-101****VII Semester**

CVHN22	Development and Applications of Special Concretes			L=3	T=0	P=0	Credits= 3
Evaluation Scheme *Best Two out of three MSE's would be considered	MSE-I*	MSE-II*	MSE-III*	TA	ESE	Total	ESE Duration
	15	15	15	30	40	100	3 Hrs.
<b>Prerequisites</b>							

COURSE OBJECTIVES	COURSE OUTCOMES
Students should be able to <ol style="list-style-type: none"> <li>To develop systematic knowledge of concrete constituents.</li> <li>To familiarize with the fundamentals of concrete</li> <li>To understand the basic concepts of special concretes</li> </ol>	Students should be able to <ol style="list-style-type: none"> <li><b>Explain</b> the properties of the constituent materials of concrete.</li> <li><b>Study</b> the fundamental concept of concrete and properties of fresh and hardened concrete.</li> <li><b>Apply</b> the use of admixtures and their role in concrete properties.</li> </ol>
<b>Mapped Program Outcomes : 5,7,8,9,11</b>	

<b>UNIT-1: Introduction to:</b> Composite material, basic properties fresh and Hardened concrete.	<b>[06 Hrs.]</b>
<b>UNIT-2: Normal Concrete:</b> Fundamentals of proportioning concrete mixes, proportioning of normal concrete mixes, concrete mix proportion: Analysis and adjustment, pores and porosity of concrete, admixture in concrete.	<b>[07 Hrs.]</b>
<b>UNIT-3: Special Concrete:</b> Curing of concrete, cold and hot weather concreting, Right Methods and Specifications, Heat of Hydration of Cement and Thermal Stresses, Anti washout Underwater Concrete, Concreting Underwater.	<b>[07 Hrs.]</b>
<b>UNIT-4: Introduction to:</b> Roller Compacted Concrete, Self Compacting Concrete, Fibre-Reinforced Concrete.	<b>[06 Hrs.]</b>
<b>UNIT-5: Introduction to:</b> Mixing of Concrete, Shotcrete, High Strength Concrete, Using Polymers in Concrete.	<b>[07 Hrs.]</b>
<b>UNIT-6: Introduction to:</b> Improving the Quality of Cover Concrete, Compaction of Concrete, Precast Concrete. concrete using recycled aggregate.	<b>[06 Hrs.]</b>

		May 2021	1.00	Applicable for AY2021-22 Onwards
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Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

**Department of Civil Engineering**

**SoE and Syllabus**

**B.E Honors in Construction Technology**



**SoE No.  
HON-101**

**Text Books:**

	<b>Title</b>	<b>Edition</b>	<b>Author</b>	<b>Publisher</b>
<b>1</b>	Concrete Technology	Second Edition	Gambhir M.L	Tata McGraw Hill
<b>2</b>	Concrete Technology		M.S. Shetty	S.Chand& Company, New Delhi
<b>3</b>	IS-7861 Code Of Practice For Extreme Weather Concreting (Part I & Part II)			

**Reference Book:**

	<b>Title</b>	<b>Edition</b>	<b>Author</b>	<b>Publisher</b>
<b>1</b>	Concrete Technology		Gupta.B.L.,Amit Gupta	Jain Book Agency
<b>2</b>	Properties of Concrete		Neville, A.M.,	Prentice Hall, London
<b>3</b>	Concrete Technology		Santhakumar.A.R.	Oxford University Press
<b>4</b>	Concrete- Microstructure, Properties and Materials		Mehta .P.K., and Paulo J.M. Monteiro	McGraw Hill
<b>5</b>	Building Materials		S.K. Duggal	New Age International Publications

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