INDIAN INSTITUTE OF TECHNOLOGY MANDI
KAMAND, DISTT. MANDI – 175075 (HIMACHAL PRADESH)

Indian
Institute of
Technology
Mandi

MINUTES OF 36TH BOARD OF ACADEMICS MEETING

VENUE   :   A-4(SC) and GUEST HOUSE (NC) CONFERENCE ROOM, KAMAND

DATE   :   30TH SEPTEMBER, 2020 (WEDNESDAY)

TIME   :   03:00 P.M.

Following members attended the meeting

Sl.No	Responsibilities	Name
1	Dean Academics	Dr. Pradeep Parameswaran
2	Associate Dean (Research)	Dr. Rahul Vaish
3	Associate Dean (Courses)	Dr. Anil K Sao
4	Chairman Library Advisory Committee	Dr. Astrid Kiehn
5	Chairman Course Proposal Committee I/c	Dr. Aditi Halder
6	Course Coordinator (IC Courses)	Dr. Aniruddha Chakraborty
7	Course Coordinator (HSS Courses)	Dr. Suman Sigroha
8	Course Coordinator (B.Tech.-CSE)	Dr. Dileep A D
9	Course Coordinator (B.Tech.-EE)	Dr. Rahul Shrestha
10	Course Coordinator (B.Tech.-ME)	Dr. Gaurav Bhutani
11	Course Coordinator (B.Tech.-CE)	Dr. Maheshreddy Gade
12	Course Coordinator (B.Tech.-EP)	Dr. Pradeep Kumar
13	Course Coordinator (B.Tech.-M.Tech. Integrated Dual Degree in Bio-Engg.)	Dr. Shubhajit Roy Chowdhury
14	Course Coordinator (M.Tech.-(Mechanical Engg. (Energy Systems))	Dr. Pradeep Kumar
15	Course Coordinator (M.Tech.-(Communication and Signal Processing))	Dr. Siddhartha Sarma
16	Course Coordinator (M.Tech.-Biotechnology)	Dr. Shyam K Masakapalli
17	Course Coordinator (M.Sc.-Applied Mathematics)	Dr. Rajendra K Ray
18	Course Coordinator (M.Sc.-Physics) + (I-Ph.D. (Physics))	Dr. Ajay Soni
19	Nominee-1: School of Engineering	Dr. Gaurav Bhutani
20	Nominee-1: School of Computing & Electrical Engineering	Dr. Srikant Srinivasan
21	Nominee-2: School of Computing & Electrical Engineering	Dr. Manas Thakur
22	Nominee-1: School of Basic Sciences	Dr. Nitu Kumari
23	Nominee-2: School of Basic Sciences	Dr. C.S.Yadav
24	Industry Member – 1	Dr. Nadeem Akhtar
25	Academic Affairs Secretary	Arnav Prasad
26	Research Affairs Secretary	Pawan Kumar Mandal
27	Assistant Registrar (Academics): Secretary	Mr. Vivek Tiwari

Following members could not attend the meeting

Sl.No.		Name	
1	Course Coordinator (B.Tech.-DSE)	Dr. Manoj Thakur	Member
2	Course Coordinator (M.Tech.- (Energy Engg. (Materials))	Dr. Sumit Sinha Ray	Member
3	Course Coordinator (M.Tech.-(Structural Engg.))	Dr. Sandip Kumar Saha	Member
4	Course Coordinator (M.Tech.-(VLSI))	Dr. Hitesh Shrimali	Member
5	Course Coordinator (M.Tech.-(Power Electronics and Drives))	Dr. Narsa Reddy Tummuru	Member
6	Course Coordinator M.Sc. (Chemistry)	Dr. Chayan K Nandi	Member
7	Course Coordinator (MA Dev. Studies)	Dr. Shyamasree Dasgupta	Member
8	Nominee-2: School of Engineering	Dr. Subhamoy Sen	Member
9	Nominee-1: School of Humanities & Social Sciences	Dr. Devika Sethi	Member
10	Nominee-2: School of Humanities & Social Sciences	Dr. Puran Singh	Member

Special Invitee

Sl.No.	Name	
1.	Dr. Mousumi Mukherjee	Asst. Prof., SE
2.	Dr. Prasad Kasturi	Asst. Prof., SBS
3.	Dr. Amit Kumar Singha	Asst. Prof., SCEE
4.	Dr. Amit B. Pawar	Asst. Prof., SBS
5.	Dr. Suman K Pal	Asso. Prof. , SBS
6.	Dr. Deepak Swami	Asst. Prof., SE
7.	Dr. Rameshwar Pratap	Asst. Prof., SCEE
8.	Dr. Adarsh Patel	Asst. Prof., SCEE

(Issues discussed by the Board of Academics when the Student Members were present)

At the outset of the meeting, the Chairman, BoA extended his thanks to the outgoing student members for their contribution and welcomed the new student members to the BoA.

36.1 **Confirmation of the minutes of 35th meeting of Board of Academics:**

The minutes of the 35th Board of Academics meeting held on 19th August, 2020 were confirmed.

36.2 **To consider approval of courses presented by the Course Proposal Committee (CPC):**

Dr. Aditi Halder, CPC I/c presented 13 new courses for the consideration and approval of the BoA. After due deliberations, the BoA decided to recommend the following 11 courses after incorporating the suggestion to the Senate for its approval.

Sl. No.	Course No.	Course Title	Credits (L-T-P-C)
1	BE 203	Enzymology and Bioprocessing	2-0-2-3
2	BY 527	Gene silencing and genome editing: principles and applications	3-0-0-3
3	CE 403	Wastewater Engineering	3-0-0-3
4	CE 512	Advanced Soil Mechanics	3-0-0-3
5	CE 513	Advanced Foundation Engineering	3-0-0-3
6	CS 563	Scalable Data Science	3-1-0-4
7	CY 647	Organic Spectroscopy	3-0-0-3
8	EE 582	Nonlinear Analysis and Control of Power Electronic Converters	3-0-0-3
9	EE623P	Practicum on Digital Control of Power Electronics and Drives	1-0-4-3
10	EE 641	Next Generation Wireless Technologies	3-0-0-3
11	PH 604	Optical Properties of Solids	3-0-0-3

The final course descriptions of the recommended courses after incorporating the suggested changes are placed at **Annexure-'A'**.

Following 02 courses were deferred by the Board for discussion in subsequent meetings.

Sl. No.	Course No.	Course Title	Credits (L-T-P-C)
1	ME 310	System Dynamics & Controls	3-0-0-3
2	PH 606	Quantum Field Theory	3-0-0-3

36.3 **To consider the modification in Core Course list for B.Tech. in Civil Engineering Curriculum:**

Dr. Maheshreddy Gade, Course Coordinator for B.Tech. Civil Engineering, made a proposal to the Board of Academics for modifications in the Core Course list for B.Tech. in Civil Engineering Curriculum. After due deliberations, the BoA recommended the proposed modifications for the consideration of the Senate and its approval. The final modified proposal is placed as **Annexure-B**.

36.4 **To consider the proposal for revision of M.Tech. program in Mechanical Engineering with Specialization in Energy System by a new name Fluid and Thermal Science:**

Dr. Pradeep Kumar, Course Coordinator for M.Tech. in MES presented the proposal to rename and modify the course structure of M.Tech program in Mechanical Engineering with Specialization in Energy System. It was noted that the proposal requires closure of existing programme (*M.Tech. in Mechanical Engineering with Specialization in Energy System*) and starting of new programme as M.Tech in Fluid and Thermal Science. Therefore, Dr. Pradeep Kumar was requested to further modify the proposal and present it during a subsequent BoA meeting.

36.5 **To consider the proposal of mandatory recording of all online lectures and put it in moodle:**

Dr. Aniruddha Chakraborty briefed Board of Academics regarding a proposal for mandatory recording of all the online lectures and upload them on moodle. The board discussed and noted that the Academic plans for Odd Semester 2020-21 has already been finalized and approved by the Senate. Some members raised concern about mandatory recording and uploading of lectures. Therefore, BoA felt that such proposals require broader discussions among faculty before taking any decision.

36.6 **Any other item with the permission of the Chair.**

The meeting ended with a vote of thanks to and by the Chair.
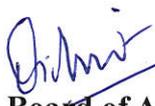
Secretary, Board of Academics
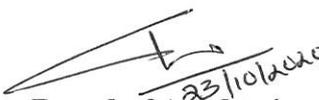
Chairman, Board of Academics 23/10/2020

Course Number: BE 203
Course Name: Enzymology and Bioprocessing
Credits: 2-0-2-3
Prerequisites: IC136
Intended for: B. Tech M.Tech. Integrated Dual Degree Bioengineering students
Distribution: Core for Integrated Dual Degree Bioengineering students, elective for other B.Tech students

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1. Preamble:

This course introduces the fundamentals of enzymology and cellular bioprocessing. The first part of the course introduces the fundamentals of enzyme catalysis and its kinetic analysis. The second part introduces bioprocessing principles and related parameters that would influence cellular growth kinetics in typical bioreactor operation conditions. The laboratory component will provide basic hands-on understanding of the enzyme kinetics and bioprocessing.

2. Course Outline:

Theory: [28 hours]

Module 1: Fundamentals of Enzymology [8 hours]
Introduction to Enzymes, Classification of Enzymes, Specificity of Enzyme Action, The Fisher 'lock-and-key' hypothesis, The Koshland 'induced-fit' hypothesis
An Introduction to Bioenergetics, Catalysis and Kinetics, Kinetics of Single-Substrate Enzyme-Catalyzed Reactions, The Henri and Michaelis Menten Equation, The Briggs Haldane modification, The Lineweaver-Burk Plot, The Eadie Hofstee and Hanes Plot

Module 2: Enzyme Inhibition and Applications [6 hours]
Reversible Inhibition: - Competitive Inhibition, Un-competitive Inhibition, Non-competitive Inhibition, Substrate Inhibition, Allosteric Inhibition and Irreversible Inhibition
Sigmoidal Kinetics and Allosteric Enzymes
Case studies pertaining to industrial enzyme(s)

Module 3: Introduction to Cellular Bioprocessing [8 hours]
Bioprocessing – definition and introduction to control parameters in Bioprocessing such as dissolved oxygen, redox, pH, temperature etc.
Stoichiometry and Kinetics of cell cultivation – Quantitative description of cell growth and product formation, Kinetic Model of Cell Growth - Monod Model.
Bioreactor types and their Operating Modes – Batch, fed-batch and continuous

Module 4: Fermentation and Downstream Processing [6 hours]
Fermentation technology and Downstream processing
Case studies on lab-scale bioprocessing of biochemicals

Lab: [28 hours]
- Enzyme kinetics –Activity analysis, Effect of substrate concentration, Effect of temperature, Effect of pH
- Process parameter control in Stirred tank Bioreactor, Microbial cultivation in a batch and estimation of growth rates, Fermentation and downstream analysis of end products

3. Text Books:

a. Trevor Palmer, Philip Bonner, "Enzymes", 2nd Edition, Woodhead Publishing, 2007.

b. Sarfaraz K. Niazi, Justin L. Brown, "Fundamentals of Modern Bioprocessing", 1st edition, CRC Press, 2017.

4. Reference Books:

a. Alejandro G. Marangoni, "Enzyme Kinetics: A Modern Approach", John Wiley & Sons, 2003.

b. Michael L. Shuler, Fikret Kargi, Matthew De Lisa, "Bioprocess Engineering: Basic Concepts", 3rd Edition, Prentice Hall, 2017.

5. Similarity content declaration with existing courses: None

Sl. No.	Course Code	Similarity Content	Approx. % of content
1	BY513	Cellular bioprocessing	20%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:
Other faculty interested in teaching this course: Dr. Amit Jaiswal

Proposed by: Dr. Shyam Kumar Masakapalli   School: SBS

Signature: Date:

Recommended/Not Recommended, with comments:

Chairman, CPC   Date:

Approved/Not approved

Chairman, Senate   Date:

Course Name	: Gene silencing and genome editing: principles and applications
Course Number	: BY527
Credits	: 3-0-0-3
Prerequisites	: IC136 or consent of the faculty member
Intended for	: UG (IDD Bioengg, 4th year) / M.Sc./M.Tech./ Ph.D.
Elective or Core	: Elective

Preamble: The main objective of this course is to introduce the concepts, developments and applications of gene silencing & genome editing technologies. This course provides a comprehensive understanding of RNAi mediated gene-silencing and CRISPR-Cas9 gene-editing technologies and potential applications to genetically modify organisms for commercial, agriculture, medical purposes. The students will learn how RNAi works, how it can be utilized to modulate gene expression and perform genetic screens in various model systems. Similarly, the students will learn discovery of CRISPR-Cas9 system, its mechanism and regulatory aspects of genome editing. As a result of this course, the students will have strong foundations and first-hand scientific understanding of current trends in gene silencing and genome editing.

Learning Outcome:

By the end of this course, students will be able to understand principles and mechanisms of RNAi and CRISPR-Cas9 technologies and their potential applications in biomedical research, agriculture, and healthcare industries. They will learn to use online tools to design RNAi (siRNAs) and CRISPR (sgRNA) constructs to knockdown and edit genes of interests. They will be able to design experiments to silence gene expression in various organisms and learn the ethical implications of genetic manipulation.

Course modules:

Module 1   *Introduction to gene structure and regulation*   **[6 hours]**
Basic principles of genome organizations, gene structure, chromatin structure, gene silencing by histone modifications, gene silencing by DNA methylation (epigenetics and genome imprinting). Eukaryotic gene structure, eukaryotic transcription, transcriptional gene silencing.

Module 2   *RNA biology*   **[6 hours]**
Post-transcriptional gene silencing. Introduction to RNAi (brief history and endogenous roles). Discovery of siRNAs and microRNAs. Molecular mechanisms RNAi. Genetic manipulations and RNAi in *C. elegans*, *Drosophila*, mammalian systems and plants.

Module 3   *Small silencing RNAs*   **[6 hours]**
Classification, biogenesis and gene-regulatory mechanisms of small RNAs. Cellular functions of small RNAs. Functions of small RNAs in developmental biology, diseases and agriculture. RNAi screens (reverse genetic screens) in cell culture and model organisms.

Module 4   *Applications of RNAi*   **[3 hours]**
RNAi-induced innate immunity and antiviral siRNAs. RNA-based therapeutics, vaccines and delivery of siRNAs. Examples of candidate RNAi drugs (Givosiran, Patisiran etc)

Module 5   *Genome editing methods-1*   **[6 hours]**
Transgenesis, site-specific chromosomal integration by Cre-LoxP, phiC31-integrase, and Mos1-transposon.

Module 6   *Genome editing methods-2*   **[6 hours]**
Genome engineering with TALENs and ZFNs. Discovery and mechanisms of CRISPR-Cas9 meditated genome editing. Different CRISPR systems and their uses in genome editing.

Module 7   **[3 hours]**
Designing of sgRNAs and repair templates. Next generation cloning technologies. Genome engineering methods for model organism. Construction of transgenics and knockouts using *C. elegans* model organism.

Module 8   *Applications of CRISPR mediated genome editing*   **[6 hours]**
Cas9 for gene regulation: CRISPR interference (CRISPRi), CRISPR activation (CRISPRa) and CRISPRon. Genome-wide CRISPR knockout screens. Applications in agriculture, food and fuel industry. Ethical concerns of genome editing by CRISPR.

Text books

1. Genome Engineering via CRISPR-Cas9 System. Edited by Vijai Singh, Pawan K. Dhar, 2020 Academic Press, ISBN 978-0-12-818140-9.
2. RNAi: A Guide to Gene Silencing. Edited by Gregory J. Hannon, 2003, Cold Spring Harbor Laboratory Press, ISBN 978-0879696412.

Reference Books

1. RNA Interference in Practice: Principles, Basics, and Methods for Gene Silencing in C. elegans, Drosophila, and Mammals. Edited by Ute Schepers, 2005, Wiley☐VCH Verlag GmbH, ISBN 978-3527310203.
2. MicroRNAs: From Basic Science to Disease Biology, Krishnarao Appasani, 2008, Cambridge University Press, ISBN 9780521865982.
3. Regulation of Gene Expression by Small RNAs. Edited by Rajesh K. Gaur, John J. Rossi. 2009, CRC Press, ISBN 978-1138111738.
4. Genome Editing and Engineering: From TALENs, ZFNs and CRISPRs to Molecular Surgery. Edited by Krishnarao Appasani, 2018, Cambridge University Press, ISBN 978-1-107-17037-7.
5. CRISPR-Cas: A Laboratory Manual. Edited by Jennifer Doudna, 2016, Cold Spring Harbor Laboratory Press, ISBN 978-1-621821-31-1.

- Relevant research articles/reviews will be advised related to the topic being taught.

Similarity Content Declaration with Existing Courses:

S.No.	Course code	Similarity content	Approx. % of content
1	Molecular Biotechnology (BY515)	Transcriptional Control of Gene Expression	< 10%

Justification for new course proposal if cumulative similarity content is > 30%: N.A.

Approvals:

Other Faculty who may be interested in teaching this course: *Dr. Prosenjit Mondal*

Proposed by Prasad Kasturi   School: SBS

Signature: _____   Date 30/09/2020

Recommended/Not Recommended, with Comments:

_____   Date: _____
Chairman, CPC
Approved / Not Approved

_____   Date: _____
Chairman, Senate

Course Number	**:** CE403
Course Name	**:** Wastewater Engineering
Credits	**:** 3-0-0-3
Prerequisites	**:** Environmental Science (IC 230)
Intended for	**:** UG/ M. Tech. /MS
Distribution	**:** Discipline Core

Preamble: The objective of this course is to help students in understanding different aspects of waste water treatment plant. The course will be helpful for the students to develop the ability to apply the understanding of the physical, chemical and biological phenomenon for an efficient design of sewage treatment plant. The course will also help them understand about the regular maintenance while operating the sewage treatment unit for sustainable recycling. The course also focuses on the advanced design constraint of wastewater treatment plant based on the feedback of the local climatic conditions. The expected outcome of the course is that the students will be able to develop and ability to estimate, design and maintain the sewage treatment plant.

Course Outline:

1. **Planning and hydraulic design of sewerage system**: Population forecasting of town, equivalent sewage flow estimation, onsite, decentralized and centralized systems, Sewer pipelines and the materials, sewers hydraulics, Storm drainage, Storm runoff estimation, sewer appurtenances, corrosion in sewers its prevention and control, sewage pumping, drainage in buildings, plumbing systems for drainage, wastewater Collection System, Instrumentation and automation techniques, .
(8 hours)

2. **Primary treatment Processes**: Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, Septic tank, Grey water harvesting ,Primary treatment ,Principles, functions and design of sewage treatment units ,screens ,grit chamber, primary sedimentation tanks ,Construction, Operation and Maintenance aspects. (8 hours)

3. **Secondary treatment Processes**: Selection of Treatment Methods, Hydraulic Principles, Functions Activated Sludge Process and Extended aeration systems, Trickling filters and their design, Sequencing Batch Reactor(SBR), Membrane Bioreactor (MBR), Waste Stabilization Ponds, Reclamation and Reuse of sewage, Recent Advances in Sewage Treatment ,Construction, Operation and Maintenance aspects. (10 hours)

4. **Sewage Disposal, Recycle and Reuse**: Standards for Disposal Methods, dilution, Mass balance principle, Self-purification of river, Oxygen sag curve, deoxygenation and reaeration, Dissolved oxygen Modelling, Land disposal, Agriculture uses of treated Sewage, Cycle of emerging organic contaminant and their effects on human health, sodium hazards, Soil dispersion system. (10 hrs)

5. **Sludge and Solid Waste Management**: Sludge characterization, Thickening, Design of gravity thickener, Sludge digestion, Standard rate and High rate digester design, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds, ultimate residue disposal.   (6 hours)

<u>**Textbooks:**</u>

1. Metcalf, L., Eddy, H. P., & Tchobanoglous, G. (1979). Wastewater engineering: treatment, disposal, and reuse (Vol. 4). New York: McGraw-Hill.
2. Karia, G. L., & Christian, R. A. (2013). Wastewater treatment: Concepts and design approach. PHI Learning Pvt. Ltd..
3. Duggal K.N., "Elements of Environmental Engineering" S. Chand and Co. Ltd., New Delhi, 2014.
4. Mackenzie L. Davis, Ph.D., P.E., DEE,. Water and Wastewater Engineering: Design Principles and Practice, McGraw-Hill Education, 2010.

<u>**Reference Books/Journals:**</u>

1. Metcalf, Leonard, Harrison P. Eddy, and Georg Tchobanoglous. Wastewater engineering: treatment, disposal, and reuse. New York: McGraw-Hill, 1979.
2. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.
3. Journal of Water Processing Engineering-Elsevier
4. Journal of Environmental Engineering-ASCE

6. **Similarity Content Declaration with Existing Courses**

S.N.	Course Code	Similarity Content	Approx. % of Content
1	CE 3XX (Wastewater Treatment)	Less than 5%	Less than 10%

Proposed by: Dr Deepak Swami   **School:** SE

Signature_____Date_____

Recommended/Not Recommended, with Comments:

_____   Date:_____

Chairman, CPC

Approved / Not Approved

_____   Date:_____

Chairman, Senate

Course Number: CE512
Course Name: Advanced Soil Mechanics
Credits: 3-0-0-3
Prerequisites: Geotechnical Engineering I (CE302) or Equivalent

Intended for: UG/PG
Distribution: Discipline Elective

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1. Preamble:

The underlying soil stratum being the basic support system for any civil engineering structure, it becomes imperative to understand the soil behavior in details. Soil being a three-phase complex system, its strength and deformation behavior significantly gets influenced by the flow of water through the soil medium and evolution of pore water pressure under applied loading. Keeping these aspects in focus, the proposed Advanced Soil Mechanics course will discuss steady state and transient flow through soil along with the stress state and stress-strain behavior of soil under different loading conditions. It will also include interpretation of different laboratory tests for estimation of shear strength of soil and various factors influencing its shear strength response.

2. Course Modules with Quantitative Lecture Hours:

Module 1: Steady State Flow through Soil (8 hours)
Laplace's Equation of Continuity; Permeability; Flow net, use and method of obtaining flow net; Numerical solution for 2D steady state flow in soil; Examples of 2D and 3D seepage in soil, seepage in anisotropic soil.

Module 2: Transient Flow in Soil (8 hours)
Compressibility and rate of consolidation; Primary, secondary and tertiary consolidation; Consolidation theories: Terzaghi and Biot's formulation, numerical solution of governing consolidation equation; Laboratory consolidation test and its interpretation.

Module 3: Strength and Deformation Behavior of Soil (11 hours)
Introduction to stress-strain behavior of soils, principal stresses, Mohr diagrams; Shear strength of cohesive and cohesionless soils, various failure criteria, drained and undrained shear strength of soils; Determination of shear strength from various laboratory tests, e.g. direct shear, triaxial, simple shear, true triaxial, hollow cylinder test, interpretation of various triaxial test results, significance of pore pressure parameters; Concept of critical void ratio; Dilation in sands.

Module 4: Stress Path Pertaining to Various Loading Conditions (4 hours)
Stress path, drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Module 5: Critical State Concept   (**11 hours**)

Critical state soil mechanics, concept of soil yielding, critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface, drained and undrained plane, complete state boundary surface.

3. Text Book:

(i) Muni Budhu, Soil Mechanics and Foundations, John Wiley & Sons, Inc., 2010.

(ii) T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley & Sons, 1991.

4. References:

(i) Jonathan Knappett and R.F. Craig, Craig's Soil Mechanics, CRC Press, 2012.

(ii) B.M. Das, Advanced Soil Mechanics, CRC Press, 2013.

(iii) James K. Mitchell, Kenichi Soga, Fundamentals of Soil Behavior, John Wiley & Sons, 2005.

(iv) J.H. Atkinson, The Mechanics of Soils and Foundations, CRC Press, 2007.

(v) Holtz, R. D., and Kovacs, W. D., An Introduction of Geotechnical Engineering, Prentice Hall, 1981.

(vi) Parry, R. H. G., Mohr Circles, Stress Paths and Geotechnics, CRC Press, 2004.

(vii) David Muir Wood, Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, 1991.

(viii) Andrew Schofield and Peter Wroth, Critical State Soil Mechanics, McGraw Hill, 1968.

(ix) Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering: Theory, Thomas Telford, USA, 1999.

5. Similarity Content Declaration with Existing Courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	CE301 Geotechnical Engineering	Introductory concepts of Seepage, Consolidation and Shear Strength	<20%
2	CE606 Constitutive Modeling of Frictional Material	Concepts of stress-strain behavior of soils	<5%

6. Justification for new course proposal if cumulative similarity content is > 30%:

Not Applicable.

Approvals:

Other faculty interested in teaching this course: Dr. Kala Venkata Uday and Dr. Ashutosh Kumar.

Proposed by: Dr. Mousumi Mukherjee   School: School of Engineering (SE)

Signature: *Mousumi Mukherjee*   Date: 30/09/2020

Recommended / Not Recommended, with comments:

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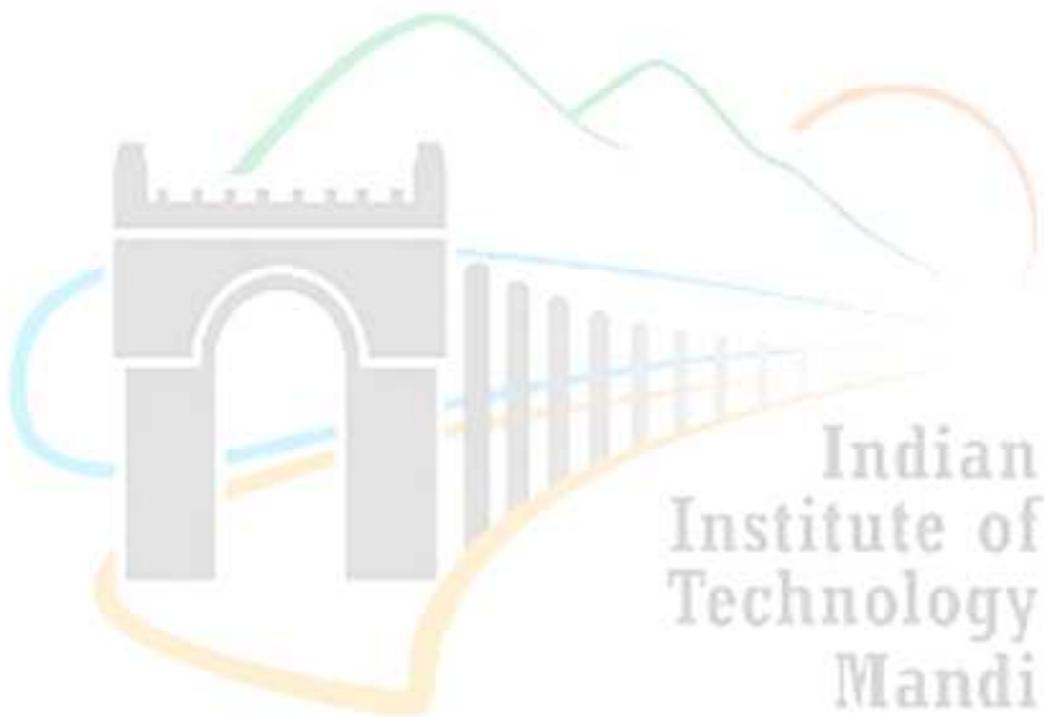Chairman, CPC   Date:

Approved / Not Approved

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Chairman, Senate   Date:

Course Number: CE513
Course Name: Advanced Foundation Engineering
Credits: 3-0-0-3
Prerequisites: Geotechnical Engineering II (CE402) or Equivalent

Intended for: UG/PG
Distribution: Discipline Elective

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1. Preamble:

Any civil engineering structure requires a foundation to transfer the superstructure load safely to the underlying soil. In this regard, it is important to estimate the bearing capacity of the soil and settlement of the foundation under the applied load. The proposed course discusses various bearing capacity theories for both shallow and deep foundations in details and it includes special scenarios like foundations resting on layered soil and sloping ground etc. It also deals with the estimation of settlement of such foundations and associated design principles.

2. Course Modules with Quantitative Lecture Hours:

Module 1: Bearing Capacity Theories for Shallow Foundation   **(4 hours)**
Foundation classification, choice of foundations; Field investigations, soil data and design parameters; Bearing capacity theories, influence of water table, soil compressibility, inclined loading, one-way and two-way eccentricity on the bearing capacity of soil.

Module 2: Bearing Capacity for Special Cases   **(4 hours)**
Bearing capacity for special cases of shallow foundations: foundations resting on layered soil, foundations supported by a soil with rigid base, foundations on sloping ground, closely placed foundations.

Module 3: Allowable Bearing Capacity and Settlement of Foundations   **(5 hours)**
Vertical stress increase in a soil mass caused by different types of foundation load; Elastic settlement of foundations, settlement of sandy soil: use of strain influence factor and field test data; Consolidation settlement; Allowable bearing capacity from field load test; Rigid and flexible foundations, contact pressure and settlement distribution beneath footings; Construction issues such as dewatering methods and underpinning of shallow foundations; Foundations on difficult soil: collapsible soils, expansive soils, and sanitary landfills.

Module 4: Mat Foundations   **(7 hours)**
Combined footings, mat/raft foundation; Bearing capacity and settlement of mat foundation; Design of mat foundation: rigid and flexible methods; Buoyancy raft or floating foundation; Skirted foundation.

Module 5: Pile Foundations   (18 hours)

Deep foundations; Load transfer mechanism for pile foundation, estimation of pile capacity, settlement of pile; Small strain and large strain dynamic tests in piles; Pile foundation design subjected to compressive load, uplift, lateral load; Design of pile groups; Pile raft; Concept of negative skin friction; Construction issues related to pile foundation, effect of adjacent constructions on existing pile foundation.

Module 6: Other Types of Deep Foundations   (4 hours)

Well foundations, classification, physical characteristics: shape, size, scour depth, components of well foundations, allowable bearing pressure, forces acting on well foundation and its lateral stability; An introduction to caisson foundation: mechanism, type and construction.

3. Text Book:
(iii) B.M. Das, Principles of Foundation Engineering, Cengage Learning, 2013.
(iv) N.N. Som and S.C. Das, Theory and Practice of Foundation Design, Prentice-Hall of India Pvt.Ltd, 2004.

4. References:
(x)   Joseph Bowles, Foundation Analysis and Design, McGraw Hill Education, 2017.
(xi)   J.H. Atkinson, The Mechanics of Soils and Foundations, CRC Press, 2007.
(xii) Muni Budhu, Soil Mechanics and Foundations, John Wiley & Sons, Inc., 2010.
(xiii) B.M. Das, Shallow Foundations: Bearing Capacity and Settlement, CRC Press, 2019.
(xiv) Michael Tomlinson and John Woodward, Pile Design and Construction Practice, CRC Press, 2014.

5. Similarity Content Declaration with Existing Courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	CE402	Basic concept of bearing capacity, settlement and introduction to different types of foundations	<25%

6. Justification for new course proposal if cumulative similarity content is > 30%:
Not Applicable.

Approvals:
Other faculty interested in teaching this course: Dr. Kala Venkata Uday and Dr. Ashutosh Kumar.

Proposed by: Dr. Mousumi Mukherjee   School: School of Engineering (SE)

Signature: *Mousumi Mukherjee*   Date: 30/09/2020

Recommended / Not Recommended, with comments:

_____
Chairman, CPC   Date:

Approved / Not Approved

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Chairman, Senate   Date:

Course Name: Scalable Data Science

Course Number: CS-563

Credits: 3-1-0-4

Prerequisite: Data Structures and Algorithms (CS202), Probability, Statistics and Random Processes (IC210), Algorithm Design and Analysis (CS403).

Students intended for: B.Tech.(3rd/4th year)/M.S./Ph.D.

Elective or Core: Elective.

Preamble: Recent advancements of the WWW, IoT, social networks, e-commerce, etc. have generated a large volume of data. Algorithms that help in gaining insights in order to make wiser decisions in large data sets are ubiquitous in several applications. Many naive algorithmic techniques may not be able to cope up with such a large volume of data by: a) running out of memory, and b) having a large running time. This course attempts to address these challenges by a) offering scalable algorithms, b) reducing the size of the data set such that the result of an algorithm on the reduced datasets is very close to its result on the original dataset. Algorithms covered in the course fit well in the intersection between theory and practice, and have guarantees on their accuracy and efficiency, and can be easily implemented.

Learning outcome: Topics covered in the course are fundamental subroutines (or sub-problems) that are required to build large scale systems. After taking this course, students will become familiar with their classical as well as state-of-the-art algorithms. They will have a theoretical understanding of the algorithms along with their practical implementation.

Course Modules:

1. **Dimensionality reduction algorithms:** Johnson-Lindenstrauss Lemma; Random Projections; Spectral Projection, and their applications [5].   (4 hours)

2. **Sketching algorithms for large data stream:** Reservoir sampling; Frequent element detection – Misra Gries algorithm; probabilistic counting – Flajolet and Martin Sketch; Set membership problem – Bloom filters and Cuckoo filters; Frequency estimation– Count Min- Sketching [8, 5].   (7 hours)

3. **Algorithm for large scale search:** Introduction to Locality Sensitive Hashing (LSH) and its variants: LSH for Jaccard Similarity – Minwise Independent Permutations (MinHash) [6] and its recent advancements (b-bit MinHash [14], One Permutation Hashing [15]); LSH for Cosine Similarity – Signed Random Projections (SimHash) [7]; LSH for Euclidean Distance [12]; LSH for Hamming distance [10].   (8 hours)

4. **Application of LSH:** Faster duplicate detection, clustering the web, large scale itemset mining, model compression. (3 hours)

5. **Mining massive graphs and applications:** Algorithms for page rank; community detection; finding overlapping communities and connected components; partitioning of graphs; counting triangles. Learning embedding of nodes with applications in link prediction, node classification. (7 hours)

6. **Clustering algorithms for large data:** Sampling algorithms for k- means clustering – k-means++ [1], scalable k-means++ [2]; spherical k-means clustering [9]; k-mode clustering [11]; spectral clustering [5]. (6 hours)

7. **Miscellaneous Topics:** Learning representation of text – word2vec [16, 13] and images – spectral hashing [17, 5] and its connection with Matrix Factorization; Topic modelling and Topic labelling [4, 3]; Building Recommendation System – a) Collaborative Filtering, b) Content based recommendation. (7 hours)

Similarity Content Declaration with Existing Courses: Following consists of a comparison between the proposed course and existing courses CS-561 (MapReduce and Big Data) and CS-660 (Data Mining and Decision Making).

1. CS-561 is more of a hands-on course which provides a thorough understanding of the MapReduce paradigm, and implementation of various algorithms on Big data platforms. However, scope of the proposed course is different and focuses on developing simple and practice algorithms with provable performance guarantees for several fundamental data science problems.
2. There are some intersections between the CS-660 and the proposed course on topics such as: a) Clustering, b) Principal Component Analysis, c) Association Rules. The intersection is less than 20%. Furthermore, the approach of covering these topics in CS-660 is different as compared to the proposed course. For these topics heuristics are covered in CS-660, while in the proposed course algorithms with provable guarantee on their accuracy and efficiency will be covered.

Proposed by: Rameshwar Pratap   **School:** SCEE

Text Books

[i] Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman. Mining Massive Datasets. 2014.

[ii] A. Blum, J. Hopcroft and R. Kannan, Foundations of Data Science, Cambridge University Press, 2020.

References

[1] David Arthur and Sergei Vassilvitskii. k-means++: the advantages of careful seeding. In Proceedings of the Eighteenth Annual ACM- SIAM Symposium on Discrete Algorithms, SODA 2007, New Orleans, Louisiana, USA, January 7-9, 2007, pages 1027–1035, 2007.

[2] Bahman Bahmani, Benjamin Moseley, Andrea Vattani, Ravi Kumar, and Sergei Vassilvitskii. Scalable k-means++. PVLDB, 5(7):622–633, 2012.

[3] Shraey Bhatia, Jey Han Lau, and Timothy Baldwin. Automatic labeling of topics with neural embeddings. In COLING 2016, 26th International Conference on Computational Linguistics, Proceedings of the Conference: Technical Papers, December 11-16, 2016, Osaka, Japan, pages 953–963, 2016.

[4] D.M. Blei, A.Y. Ng, and M.I. Jordan. Latent Dirichlet allocation. the Journal of Machine Learning research, 3:993–1022, 2003.

[5] Avrim Blum, John Hopcroft, and Ravindran Kannan. Foundations of data science, 2015.

[6] Andrei Z. Broder, Moses Charikar, Alan M. Frieze, and Michael Mitzenmacher. Min-wise independent permutations (extended abstract). In Proceedings of the Thirtieth Annual ACM Symposium on the Theory of Computing, Dallas, Texas, USA, May 23-26, 1998, pages 327–336, 1998.

[7] Moses Charikar. Similarity estimation techniques from rounding algorithms. In Proceedings on 34th Annual ACM Symposium on Theory of Computing, May 19-21, 2002, Montréal, Québec, Canada, pages 380– 388, 2002.

[8] Graham Cormode. Sketch techniques for approximate query processing. In Synopses for Approximate Query Processing: Samples, Histograms, Wavelets and Sketches, Foundations and Trends in Databases. NOW publishers, 2011.

[9] Inderjit S. Dhillon and Dharmendra S. Modha. Concept decompositions for large sparse text data using clustering. Machine Learning, 42(1/2):143–175, 2001.

[10] Aristides Gionis, Piotr Indyk, and Rajeev Motwani. Similarity search in high dimensions via hashing. In VLDB'99, Proceedings of 25th International Conference on Very Large Data Bases, September 7-10, 1999, Edinburgh, Scotland, UK, pages 518–529, 1999.

[11] Zhexue Huang. Extensions to the k-means algorithm for clustering large data sets with categorical values. Data Mining and Knowledge Discovery, 2(3):283–304, Sep 1998.

[12] Piotr Indyk and Rajeev Motwani. Approximate nearest neighbors: Towards removing the curse of dimensionality. In Proceedings of the Thirtieth Annual ACM Symposium on the Theory of Computing, Dallas, Texas, USA, May 23-26, 1998, pages 604–613, 1998.

[13] Omer Levy and Yoav Goldberg. Neural word embedding as implicit matrix factorization. In Advances in Neural Information Processing Systems 27: Annual Conference on Neural Information Processing Systems 2014, December 8-13 2014, Montreal, Quebec, Canada, pages 2177–2185, 2014.

[14] Ping Li and Arnd Christian König. b-bit minwise hashing. In Proceedings of the 19th International Conference on World Wide Web, WWW 2010, Raleigh, North Carolina, USA, April 26-30, 2010, pages 671–680, 2010.

[15] Ping Li, Art B. Owen, and Cun-Hui Zhang. One permutation hashing. In Advances in Neural Information Processing Systems 25: 26th Annual Conference on Neural Information Processing Systems 2012. Proceedings of a meeting held December 3-6, 2012, Lake Tahoe, Nevada, United States, pages 3122–3130, 2012.

[16] Tomas Mikolov, Ilya Sutskever, Kai Chen, Gregory S. Corrado, and Jeffrey Dean. Distributed representations of words and phrases and their compositionality. In Advances in Neural Information Processing Systems 26: 27th Annual Conference on Neural Information Processing Systems 2013. Proceedings of a meeting held December 5-8, 2013, Lake Tahoe, Nevada, United States, pages 3111–3119, 2013.

[17] Yair Weiss, Antonio Torralba, and Rob Fergus. Spectral hashing. In D. Koller, D. Schuurmans, Y. Bengio, and L. Bottou, editors, Advances in Neural Information Processing Systems 21, pages 1753–1760. Curran Associates, Inc., 2009.
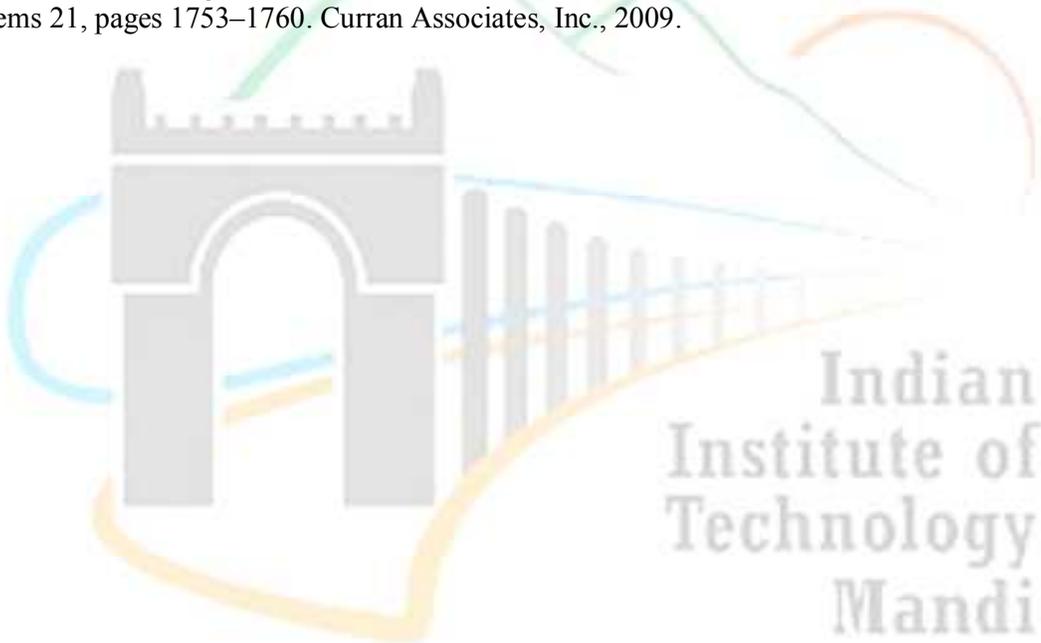
IIT Mandi
Proposal for a New Course

Course Title : **Organic Spectroscopy**
Course Number : **CY 647**
Credits : **3-0-0-3**
Prerequisites :
Intended for : **MSc Chemistry and PhD** (any discipline)
Distribution : **Elective Course**
Preamble:

The main objective of this course is to teach fundamental principles of various spectroscopic techniques used for structural elucidation of organic compounds. Along with the fundamental aspects, the focus will be given on problem solving which can help students from research perspective.

Modules:

1. UV Spectroscopy   (4 Hrs)

Introduction, Principle of UV spectroscopy, Concept of chromophore, Solvent effect, Fluorescence and phosphorescence, Characteristic absorption of organic compounds, Woodward-Fieser rules for dienes and enones, Substituent effects, Model compound studies.

3. Infra-red (IR) Spectroscopy   (4 Hrs)

Introduction, Molecular vibrations, factors influencing molecular frequencies, Infrared spectrometer, application of IR spectroscopy for identification of functional groups.

2. Mass Spectroscopy   (4 Hrs)

Basic principle, Ionization methods, Determination of molecular weight and molecular formula, Molecular ion and its recognition, Fragmentation and rearrangements, Examples of organic compounds from different classes such as hydrocarbon, hydroxy compounds, ketones, aldehydes, carboxylic acids and esters, lactones, amines and amides, nitro compounds, nitriles and heteroaromatic compounds

4. ^{1}H NMR Spectroscopy   (12 Hrs)

The NMR Phenomenon, Theory of nuclear magnetic resonance, Chemical shift and factors affecting chemical shift, integral and integration in proton NMR, Chemical equivalence and magnetic equivalence, First order and second order spectra, Spin-spin coupling, Pascal's triangle, Coupling constant, Factors influencing coupling constant, A_2, AB, and AX spin systems, AMX, ABX and ABC spin system with three coupling constants, D_2O exchange, Shift reagents, Effect of chiral center, ^{19}F and ^{31}P NMR, Structure elucidation of organic compound using ^{1}H NMR.

4. ^{13}C NMR Spectroscopy and 2-D NMR spectroscopy   **(10 Hrs)**

Introduction, Correlation chart for ^{13}C chemical shift, Proton-coupled ^{13}C spectra, Proton-decoupled ^{13}C spectra, carbon-deuterium coupling, NOE effects, Structural applications of ^{13}C NMR, Fundamentals and applications of DEPT technique in NMR spectroscopy, Application of 2-D NMR spectroscopic techniques such as ^{1}H-^{1}H COSY, ^{1}H-^{13}C COSY, HMBC and HSQC for structure determination of complex organic compounds.

5. Structural Elucidation of Organic Compounds   **(8 Hrs)**

Interpretation of spectroscopic data of unknown compounds, Application of UV-Vis, MS, IR and NMR spectroscopic techniques for solving structure of organic molecules

Textbooks:

1. NMR Spectroscopy 2nd Edition, Harald Gunther, Wiley Publishers.
2. Modern NMR Spectroscopy: A workbook of Chemical Problems 2nd Edition, Jeremy K.M. Sanders, Edwin C. Constable, Brian K. Hunter and Clive M. Pearce Oxford University Press.
3. Organic Structure Determination, using 2-D NMR Spectroscopy, a problem-based approach, Jeffrey H. Simpson

References:

1. Structure Determination of Organic Compounds, Tables of Spectral Data, Erno Pretsch, Philippe Buhlmann, Martin Badertscher, Springer.
2. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David Kiemle, John Wiley & Sons; 7th Edition edition.
3. Organic Spectroscopy 3rd Edition, William Kemp, Palgrave Publishers Ltd

Approvals:

Other Faculty interested in teaching this course: Dr. Amit B. Pawar

Proposed by: Dr. Subrata Ghosh, School of Basic Sciences, IIT Mandi.

Signature_____Date_____---------------------

Recommended/Not Recommended, with Comments:
_____ Date:_____

Chairman, CPC Approved / Not Approved

Course number: EE 582
Course Name: Nonlinear Analysis and Control of Power Electronic Converters
Credit: L-T-P-C: 3-0-0-3
Prerequisite: Control Systems (EE301) & Power Electronics (EE 309)
Intended for: UG/PG
Elective/Core: Elective

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1. **Preamble:** Power electronic converters exhibit a variety of nonlinear phenomena due to the presence of switching elements, control loop, etc. This course deals with different mathematical tools to analyze those phenomena. Also, a few nonlinear control techniques are covered in this course to improve the transient performance compared to the linear controllers.

2. ## Course Modules with quantitative lecture hours:

Module 1: Introduction [6 hours]
Introduction to nonlinear models, nonlinear phenomena, common nonlinearities, qualitative behavior of linear systems, phase portraits, limit cycle oscillation, Jacobi linearization, direct method and indirect method of Lyapunov

Module 2: Sources of Nonlinearities in Power Electronic Converters [3 hours]
 Nonlinearity due to switch and reactive components, nonlinearity introduced by the closed loop control, nonlinear phenomena observed in power electronic converters

Module 3: Control techniques for power electronic converters:
Voltage mode control, current mode control, PWM of type 1 and type 2, hysteresis control, sliding mode control, digital control, time optimal control [7 hours]

Module 4: Dynamic Modeling Techniques [4 hours]
Average modelling of PWM converters, limitations of average model, Discrete-time 1-D and 2-D models

Module 5: Stability Analysis [7 hours]
Basics of bifurcation theory and chaos, bifurcation of smooth and piecewise-smooth maps, nonstandard bifurcation in discontinuous maps, techniques of experimental investigations

Module: 6 Describing Function Analysis of Power Electronic Converters [7 hours]
Basics of describing function, describing function of different nonlinearities, stability analysis of limit cycle using Nyquist criteria

Module: 7 Simulation Study [7 hours]
Matlab based project work on i) Analysis of instability introduced by the different nonlinear components, ii) Nonlinear controller design to improve transient performance and stability boundary.

3. Text books:

S. Banerjee and G. C. Verghese, Eds*., Nonlinear Phenomena in Power Electronics: Attractors, Bifurcations, Chaos, and Nonlinear Control*. New York: IEEE Press, 2001.

4. References:

I. H. K. Khalil, *Nonlinear Control*, Pearson Education**,** 2015

II. C. K. Tse*, Complex Behavior of Switching Power Converters*. New York: CRC, 2003.

III. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics Converters, Applications, and Design*, 3rd ed., Wiley India, 2008

IV. R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, 2nd ed. Dordrecht, The Netherlands: Kluwer, 2001.

V. L. Corradini, R. Zane, D. Maksimović, P. Mattavelli, *Digital Control of High-Frequency Switched-Mode Power Converters*, John Wiley & Sons, 2015

5. Similarity content declaration with existing courses: less than 17% (module 1 and some portion of module 4)

(i)   Switch Mode Power Conversion (EE504)
(ii)   Nonlinear systems: stability and control (EE 515)

6. Justification of new course proposal if cumulative similarity content is >30%: NA

Approvals:

Other Faculty interested in teaching this course: -

Proposed by: Dr. Amit Kumar Singha   School: SCEE
Signature: Date:

_____

Recommended/Not Recommended, with Comments:

_____   Date:_____
Chairman, CPC
Approved / Not Approved

_____   Date:_____
Chairman, Senate

Course Number: EE623P
Course Name: Practicum on Digital Control of Power Electronics and Drives
Credits: 1-0-4-3
Prerequisites: Switch Mode Power Conversion (EE504), Fundamentals of Electric Drives (EE508), Analysis and Design of Power Electronic Converters (EE527)
Intended for: PG/UG
Distribution: Core for M. Tech (PED), Elective for UG and other PG courses

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1. Preamble: Practicum on Digital Control of Power Electronics and Drives is a lecture + laboratory course designed to provide the students with a hands-on experience on practical implementation of digital control of power electronic converters and motor drives using microcontroller/Field Programmable Gate Array (FPGA). This course will help the students to explore the benefits and challenges of implementing digital control.

2. Course Modules with Quantitative Lecture Hours: This course has an hour of lecture session accompanied by four hours of laboratory session per week. List of course modules and experiments are provided below.

   I.   Introduction to digital control, microprocessor/FPGA   **(5+20 hours)**
           Lecture: Why digital control, challenges in digital platform, fixed-point and floating-point representations, sampling, mathematical modelling of sampling, quantization and its impact on stability, s-domain to z-domain mapping (tustin, forward difference, backward difference), stability analysis in z-domain, discretization of analog controllers.
           Laboratory: Implementation of various building blocks (ADC sampling, PWM block, controller block) required for closed-loop control of power electronic converters (using C/Verilog coding).

  II.   Closed-loop control of DC-DC converters   **(5+20 hours)**
           Lecture: Controller design techniques, discretization of analog controllers, different types of delays introduced by the digital controllers.
           Laboratory: Implementation of digital voltage mode control, load transient performance, soft start-up, anti-windup arrangement.

 III.   **Lecture:** Digital Proportional-Resonant and Proportional Integral controller design for a single-phase and a three-phase voltage source inverter
           Laboratory: Implementation of a single-phase voltage source inverter with different loads (standalone case), digital controller design and implementation of different modulation techniques in a three-phase voltage source converter **(2+8 hours)**

 IV.   **Lecture:** Design of a digital controller in a buck fed DC motor
           Laboratory: Digital implementation of closed-loop control   **(1+4 hours)**

  V.   **Lecture:** Digital V/F controller design in an induction machine
           Laboratory: Implementation of digital V/F control

                                                                    (1+4 hours)

3. Textbooks:

    B. C. Kuo, *Digital Control Systems*, Oxford University Press, 2012

    N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics Converters, Applications, and Design*, 3rd ed., Wiley India, 2008

4. References:

S. N. Vukosavic, *Digital Control of Electrical Drives,* springer, 2017

R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, 2nd ed. Dordrecht, The Netherlands: Kluwer, 2001.

Similarity Content Declaration with Existing Courses: N/A
Justification for new course proposal if cumulative similarity content is >30%: N/A
Approvals:

Other faculty interested in teaching this course: Dr. Himanshu Misra

Proposed By: Dr. Amit Kumar Singha

Signature:

Recommended/Not Recommended, with comments:

_____Chairman, CPC

Approved/Not Approved
_____
Chairman, Senate
School: SCEE
Date:

Course Name: Advance Wireless Technologies
Course Number: EE641
Credits: 3-0-0-3
Prerequisites: EE304, EE503.
Intended for: UG and PG.
Distribution: Discipline elective for 3rd/ 4th year B.Tech. (CSE and EE)/ MS/ M.Tech./ PhD
and free elective for other branches.

Preamble:
This course will introduce various next generation wireless technologies to the students. The objective
of the course is to help students to analyze, compare and verify the performance and suitability of the
recent and upcoming wireless technologies. A firm understanding of the fundamentals of these next
generation wireless technologies will motivate the students to take up challenging projects/ research
problems in the related fields.

Learning outcome:
After taking this course, students will

1. be familiar with the upcoming wireless technologies of the next generation networks.
2. develop an intuitive understanding of various key wireless technologies unique to 5G networks.

3. get an analytical and conceptual understanding of the wireless technologies.
4. learn to analyze the performance of various aspects of the next generation wireless techniques, and
   conduct simulations to corroborate the analytical results.

5. The course will expose the students to the challenges in the next generation wireless technologies
   and hence will provide a platform to do cutting edge research.

Modules:
Introduction: (7 lecture hours) Challenges of next generation wireless networks. Basics of wireless
communications, multipath propagation and fading nature of wireless channel, BER. Performance of
multi-antenna wireless systems, precoding and power allocation for multi-user MIMO systems.

Cognitive Radio Systems: (5 lecture hours) Concepts, challenges of Software Defined Radio (SDR),
spectrum-sensing techniques, optimal power allocation, Interference suppression, and robust detection.

Massive MIMO Systems: (7 lecture hours) Introduction and challenges. Signal processing with perfect
& imperfect channel state information, rate scaling, performance of multi-cell massive MIMO systems
and spatial modulation.

mmWave/THz Wireless Systems: (6 lecture hours) Introduction, properties and modeling of wireless
channels, analog, digital and hybrid processing, sparse processing, channel estimation, optimal
precoders and combiners.

Cooperative Wireless Communication: (6 lecture hours) Introduction to cooperative communication and cooperation protocols (AF, DF, and SDF). Performance analysis of DF for MIMO and multi-relay wireless systems.

Non-Orthogonal Multiple-Access (NOMA): (6 lecture hours) Introduction, system model and decoding for NOMA systems. Outage probability, opt. performance, average rate, key aspects of uplink and downlink NOMA systems.

Full-Duplex Wireless Technology: (5 lecture hours) Introduction, self-interference and resulting performance. Optimal signal processing, power allocation and performance of FD Systems.

Optional topics:

Molecular Communication, Backscatter Communication, Energy Harvesting, Low Power Wide-area Networks (LPWA), Long Range Wireless Transfer (LoRa), D2D, Distributed MIMO, Physical layer caching and Physical layer security.

Key Text books:

1. Luo, Fa-Long and Zhang, Charlie (Jianzhong), Luo, Fa-Long, *Signal processing for 5G: algorithms and implementations,* Wiley-IEEE Press, 2017.

2. Wei Xiang, Kan Zheng, Xuemin - 5G Mobile Communications, Springer, 2017.

Key Reference Material:

1. Wong V., Schober, R., Ng, D., & Wang, L. (Eds.), *Key Technologies for 5G Wireless Systems.* Cambridge, 2017.

2. Dahlman, E., Parkvall, S., & Sköld, J., *5G NR: The next generation wireless access technology.* Elsevier 2018.

3. A. Chockalingam, B. S. Rajan, *Large MIMO Systems*, Cambridge, 2014.

4. Liu, K., Sadek, A., Su, W., & Kwasinski, A, *Cooperative Communications and Networking.* Cambridge University Press, 2008.

5. Tho Le-Ngoc, Ahmed Masmoudi, *Full-Duplex Wireless Communications Systems*, Springer, 2017.

6. Biglieri, Ezio, Andrea J. Goldsmith, Larry J. Greenstein, Narayan B. Mandayam and Herve Vincent, *Principles of Cognitive.* Cambridge, 2012.

7. N. Farsad, H. B. Yilmaz, A. Eckford, C. Chae and W. Guo, "A Comprehensive Survey of Recent Advancements in Molecular Communication," in *IEEE Communications Surveys & Tutorials*, vol. 18, no. 3, pp. 1887-1919, 2016.

Content Similarity Declaration with Existing Courses: N/A

Sr #	Course code	Similarity content	Approx. % of content
1	EE517: Wireless Communication and Networking	Basics of wireless communications, multipath propagation and fading nature of wireless channel, BER. Performance of multi-antenna wireless systems.	21 %

Justification for new course proposal if cumulative similarity content is > 30%:
N.A.

Approvals:
Other Faculty who may be interested in teaching/co-teaching this course:

Dr. Samar Agnihotri
Dr. Satyajit Thakor
Dr. Gopi Shrikanth Reddy

Proposed by Dr. Adarsh Patel **School**: SCEE

Signature:

Date

Recommended/Not Recommended, with Comments:

Date: Chairman, CPC

Approved / Not Approved

Date: Chairman, Senate

IIT Mandi
Proposal for a New Course

Course Name : **Optical Properties of Solids**
Course Number : **PH 604**
Credits : **(3-0-0-3)**
Prerequisites : Mathematical Physics (PH511) or Mathematics-2 (EP301), Quantum Mechanics (PH513) or Quantum Mechanics and Applications (PH301), Electromagnetic Theory (PH521) or Foundation of electrodynamics (IC221), Condensed Matter Physics (PH523) or Solid State Physics (PH501)
Intended for Distribution: Elective
Semester : Odd/Even

Preamble : The study of optical properties of solids is very important to understand optoelectronics technology in the 21st century. The objective of this course is to know about the classical and the quantum theory of light-matter interactions, optical properties of low dimensional materials and the nonlinear optical effects in solids.

Course Outline : The course is focused on the optical properties of several classes of materials. It starts with the classical description of optical processes taking place in solids. Subsequently, it covers the treatment of absorption and luminescence by quantum theory, and the excitonic effects. The optical phenomena of semiconductors and metals are covered with emphasis on quantum structures. The course also includes discussion about the effect of phonons on optical properties. Finally, a brief introduction to nonlinear optical properties is introduced.

Modules:

Introduction: Optical processes, the complex refractive index and dielectric constant, quantum theory of radiative transition. [3]

Propagation of light in solid: Phenomenological models-Drude and Lorentz models. quantum mechanical description, linear response functions and Kramers–Kronig relations, dispersion, birefringence, optical anisotropy. [4]

Absorption of light: Interband transitions, transition rate, absorption in direct and indirect semiconductor, spin-orbit coupling, indirect gaps, Urbach tails, Landau levels, Franz-Keldysh effect, and absorption spectra. [3]

Excitons: Frenkel vs. Wannier excitons, optical selection rules, effect of Coulomb interaction on interband absorption, Franck-Condon approximation, Huang-Rhys model, Wannier exciton – LO phonon bound states. [3]

Luminescence: Emission from solids, Interband luminescence, photo and electro luminescence, photoluminescence spectroscopy. [3]

Quantum structures: Low dimensional materials and their electronic structures, absorption of quantum well, quantum confined Stark-effect, photoluminescence, optical properties of quantum dots, recent advancement in confined optical materials like zero and two-dimensional materials.
[6]

Plasmonic systems: Metals, doped semiconductors, free carrier absorption and plasmons, surface and slab plasmons, plasmons in metallic particles, negative refraction. [3]

Light-phonon interactions: Infrared and Raman active phonons, Phonons absorption and reflectivity, polaritons, polarons, inelastic light scattering (Raman and Brillouin scattering), Feynman diagrams for light scattering. [4]

Impurity centers in semiconductors: Electronic spectrum of shallow donors, multiple valleys, valley-orbit coupling and acceptors, pseudospin-orbit coupling, impurity bands and metal-insulator transition, localized vibrational modes, LO modes bound to neutral impurities, lattice dynamics of isoelectronic impurities and mixed crystals. [5]

Nonlinear optics: optical nonlinearities, second order nonlinearities, third-order nonlinearties, optical Kerr effect, stimulated Raman scattering, generation and detection of terahertz radiation and recent advancement in this field. [6]

Books:

Text
1. Optical Properties of Solids by Mark Fox, Oxford University Press (2010)

References
1. Optical Processes of Solids by Yutaka Toyozawa, Oxford University Press (2010)
2. Optical Properties of Solids by Frederick Wooten, Academic Press (2013)
3. Solid State Physics Part II Optical Properties of Solids by M. S. Dresselhaus (2001).

Online resources: No

Similarity Content Declaration with Existing Courses:

Sl. No.	Course code	Similarity content	Percentage
1	PH 502 Photonics	Absorption and dispersion	<2%
2	PH 523 Condensed Matter Physics	Bound State and optical transitions in semiconductors	< 5%

Justification for new course proposal if cumulative similarity content is > 30%:
N/A

Approvals*:*
Other Faculty interested in teaching this course: Dr. Pradeep Kumar (SBS)

Proposed by: Dr. Suman Kalyan Pal **School:** School of Basic Sciences (SBS)

Signature: Date:

Recommended/Not Recommended, with Comments:

_____   Date:_____
Chairman, CPC

Approved / Not Approved

_____   Date:_____

Chairman, Senate

Motivation

The development of a country primarily depends on the availability of physical infrastructure and facilities for civil society. These Infrastructures play a vital role in the improvement of the country's economic growth and standard of living. The adequate infrastructure in the form of road and railway transport system, ports, power plants, airports and their efficient working is also essential for integration of the country's economy with other economies of the world. A civil engineer plays an important role in developing and maintaining these infrastructures. Our country, which is investing significantly to improve its infrastructure facilities like metro rails, smart cities, express ways, highways, ports, airports, dedicated freight corridors, etc. to cope up with its ever-increasing needs, requires high quality civil engineers who can handle these specific projects. As one of the premium institutes in India, IIT Mandi offers both UG and PG programmes in civil engineering to train students who can take up the real-world challenges.

The undergraduate Civil Engineering programme at IIT Mandi is designed to recognize the modern pace of development in infrastructure across the world. This programme provides basic knowledge in engineering geology, construction materials, solid, fluid and soil mechanics, environmental science and engineering that helps in planning, design and construction of bridges, buildings, hydraulic structures, environmental systems, and transportation systems including highways, railways, airports etc. Along with this broad training, students are also encouraged to pursue elective courses in any specialized areas of Civil Engineering like structural engineering, geotechnical engineering, transportation engineering, and environmental engineering. A two–semester project during the fourth year of the B.Tech programme is intended to synthesize their knowledge in selected specialized area of Civil Engineering. Students are also encouraged to take up courses from other disciplines as open electives to carry out interdisciplinary projects during their due course of the programme. The students, who are equally inclined towards other disciplines, can take the necessary courses under relevant program and get a minor.

Objectives of the program

- To impart knowledge on application of principles of physics and mathematics, blended with modern data science, to provide solutions for common to most extraordinary problems of society.

- To train how to plan, analyse, design, execute and manage the civil engineering projects.

- To develop industry-ready manpower, who are capable to take up challenging and state-of-the-art infrastructure projects.

- To motivate the students for higher education and research to become experts in specialized fields in order to come up with innovative and economical solutions for real world problems.

List of Core Courses for Civil Engineering Program

(Total Credits for Discipline Core = 33)

Course No.	Course Title	Lecture	Tutorial	Practical	Total Credit	Semester
CE201	Surveying Traditional and Digital	2	0	2	3	3
CE251	Hydraulics Engineering	3	0	0	3	3
CE304P	Hydraulics Engineering Lab	0	0	2	1	3
CE301	Strength of Materials and Structures	3	0	2	4	4
CE302	Geotechnical Engineering	3	0	2	4	4
CE303	Water Resources Engineering	3	0	0	3	5
CE305P	Environment and Earth Science Lab	0	0	2	1	5
CE351	Design of Reinforced Concrete Structures	2	1	0	3	5
CE352	Transportation Engineering	3	0	0	3	5
CE353P	Civil Engineering Drawing	0	0	2	1	5
CE354P	Building and Pavement Materials Lab	0	0	2	1	5
CE401	Design of Steel Structures	2	1	0	3	6
CE403	Wastewater Engineering	3	0	0	3	6

Semester wise distribution of all courses
(Minimum credit requirements for B.Tech. degree 160 credits)

Abbreviations	
IC	Institute Core Subject (compulsory to all branches of B.Tech.)
DC	Discipline Core Subject (branch specific compulsory courses)
DE	Discipline Elective Subject (branch specific elective courses)
OE	Open Elective (elective open to all branches of B.Tech.)
MTP (total 8 credits)	Major Technical Project (optional, students may opt for courses instead)

1st Sem.						
S. No.	Core/ Elective	Course Name	Lecture	Tutorial	Practical	Credit
1	IC110	Engineering Mathematics	2.5	0.5	0	3
2	IC152	Computing and Data science	3	0	2	4
3	IC160	Electrical Systems Around Us	2.5	0.5	0	3
4	IC160P	Electrical Systems Around Us Lab	0	0	3	2
5	IC140	Graphics for design	2	0	3	4
6	IC101P	Reverse Engineering	0	0	3	2
7	HS107	Exploring Creative Arts Form				1
8	HSXXX	HSS basket Course	3	0	0	3
					Total Credit	22

2nd Sem.						
S. No.	Core/ Elective	Course Name	Lecture	Tutorial	Practical	Credit
1	IC111	Linear Algebra	2.5	0.5	0	3
2	IC141	Product Realization Technology	2	0	0	2
3	IC141P	Product Realization Technology Lab	0	0	3	2
4	IC161	Applied Electronics	3	0	0	3
5	IC161P	Applied Electronics Lab	0	0	3	2
6	IC142	Engineering Thermodynamics	3	0	0	3
7	IC252	Data Science II	3	0	2	4
8	HSXXX	HSS basket Course	3	0	0	3
					Total Credit	22

		3rd Sem.				
S. No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC240	Mechanics of Rigid Bodies	3	0	0	3
2	IC272	Data Science III	2	0	2	3
3	CE201	Surveying: Traditional and Digital	2	0	2	3
4	CE251	Hydraulics Engineering	3	0	0	3
5	CE304P	Hydraulics Engineering Lab	0	0	2	1
6	HSXXX	HSS basket Course	3	0	0	3
7	HSXXX	HSS basket Course	3	0	0	3
8	ICXXX	Science I Basket	3	0	0	3
					Total Credit	**22**

		4th Sem.				
S. No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC221	Foundations of Electrodynamics	3	0	0	3
2	IC222P	Physics Practicum/Practical	0	0	3	2
3	ICXXX	Science II Basket	3	0	0	3
4	IC201P	Design Practicum	0	0	6	4
5	CE301	Strength of Materials and Structures	3	0	2	4
6	CE302	Geotechnical Engineering	3	0	2	4
7	ICXXX	Eng. Sciences Basket	3	0	0	3
					Total Credit	**23**

		5th Sem.				
S. No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	CE303	Water Resources Engineering	3	0	0	3
2	CE351	Design of Reinforced Concrete Structures	2	1	0	3
3	CE352	Transportation Engineering	3	0	0	3
4	CE353P	Civil Engineering Drawing	0	0	2	1
5	CE305P	Environment and Earth Science Lab	0	0	2	1
6	OE – 1	Open Elective				3/4
7	CEXXX	Discipline Elective	3	0	0	3
8	OE – 2	Open Elective				3/4
					Total Credit	**20 - 21**

		6th Sem.				
S. No.	Core/ Elective	Course Name	Lecture	Tutorial	Practical	Credit
1	CE401	Design of Steel Structures	2	1	0	3
2	CE403	Wastewater Engineering	3	0	0	3
3	CE354P	Building and Pavement Materials Lab	0	0	2	1
4	CEXXX	Discipline Elective				3/4
5	OE – 3	Open Elective				3/4
6	HSXXX	HSS Elective				3/4
7	OE – 4	Open Elective				3/4
					Total Credit	**19 - 23**

		7th Sem.				
S. No.	Core/ Elective	Course Name	Lecture	Tutorial	Practical	Credit
1	CEXXX	Discipline Elective				3/4
2	CEXXX	Discipline Elective				3/4
3	OE – 5	Open Elective				3/4
4	HSXXX	HSS Elective				2/3
5	DP401P	MTP-I				3
6	ITXX1	Internship	0	0	2	2
					Total Credit	**15-23**

		8th Sem.				
S. No.	Core/ Elective	Course Name	Lecture	Tutorial	Practical	Credit
1	OE – 6	Open Elective				3/4
2	OE – 7	Open Elective				3/4
3	DP402P	MTP-II				5
					Total Credit	**11-13**

Tentative List of Discipline Elective Courses

S. No.	Course	Course Name	Lecture	Tutorial	Practical	Credit
Geology and Remote Sensing						
1	CE252	Geology and Geomorphology	2	0	2	3
2	CE508	Photogeology and Photogrammetry	2	0	2	3
3	CE501	Remote Sensing	2	0	2	3
4	CE601	Geo-Informatics	2	0	1	3
Geotechnical Engineering						
5	CE402	Geotechnical Engineering-II	2	1	0	3
6	CE504	Slope Stability and Retaining Structures	3	0	0	3
7	CE505	Engineering of Ground Modification	3	0	0	3
8	CE551	Geosynthetics and their applications	3	0	0	3
9	CE560	Soil Dynamics	3	0	0	3
10	CE606	Constitutive Modeling of Frictional Material	3	0	0	3
Structural Engineering						
11	CE506	Analysis of Indeterminate Structures	3	0	0	3
12	CE507	Advanced Concrete Science	3	0	0	3
13	CE509	Bridge Engineering	3	0	0	3
14	CE511	Structural Dynamics with Application to Earthquake Engineering	3	0	0	3
15	CE552	Concrete Technology	3	0	0	3
16	CE 554	Prestressed Concrete Structure	3	0	0	3
17	CE555	Advanced Design of Structures	3	0	0	3
18	CE556P	Structural Engineering Laboratory	0	0	4	2
19	CE557	Solid Mechanics in Structural Engineering	3	0	0	3
20	ME513	Finite Element Methods in Engineering	3	0	2	4
21	CE605	Engineering Seismology and Seismic Hazard Assessment	3	0	0	3
22	CE610	Analysis and Design for Earthquake Resistant Structures	3	0	0	3
23	CE611	Structural Health Monitoring	3	0	0	3
24	CE612	Theory of Plates and Shells	3	0	0	3
Water Resource and Environmental Engineering						
25	CE355	Hydrology	3	0	0	3
26	CE502	Groundwater Flow and Contaminant Transport Modeling	3	0	0	3
27	CE510	Modelling and Simulation in Water Resources Engineering	2	0	2	3
28	CE558	Air Pollution and its Mitigation	3	0	0	3
29	CE559	Biological Wastewater Treatment	3	0	0	3