

National Institute of Technology, Arunachal Pradesh  
Yupia, Arunachal Pradesh – 791112



Minutes of the 21st Senate Meeting of NIT, Arunachal Pradesh held on 11/11/2019  
at 02:30 pm at NIT-Arunachal Pradesh, Yupia, Papumpare

Following Members were present:-

- |  |                   |
|--|-------------------|
| 1. Prof. (Dr.) Pinakeswar Mahanta, Director, NIT Arunachal Pradesh | - Chairman        |
| 2. Prof. Ayon Bhattacharjee, Professor, NIT Meghalaya              | - Member          |
| 3. Prof. Jумыr Basar, Associate Professor, RGU, AP                 | - Member          |
| 4. Prof. S. N. Shome, Professor, ME, NIT AP                        | - Member          |
| 5. Prof. Isha T.B., Professor, EE, NIT AP                          | - Member          |
| 6. Dr. Uday Kumar Khanikar, Registrar NIT, Arunachal Pradesh       | -Member Secretary |
| 7. Dr. M. Mallik, Associate Professor/CE, NIT, Arunachal Pradesh   | - Invitee         |
| 8. Dr. Rajen Pudur, DIC(A&E), NIT, Arunachal Pradesh               | - Invitee         |
| 9. Dr. K. R. Singh, Asso. DIC(A&E), NIT, Arunachal Pradesh         | - Invitee         |
| 10. Prof. M.K. Shome, Professor, NIT Arunachal Pradesh             | - Invitee         |
| 11. Prof. R.P. Sharma, Asso. Professor, NIT, Arunachal Pradesh     | - Invitee         |
| 12. Dr. J. Taipodia, HoD CE, NIT, Arunachal Pradesh                | - Invitee         |
| 13. Dr. K. Mondal, HoD/CHE, NIT, Arunachal Pradesh                 | - Invitee         |
| 14. Dr. Anup Paul, HoD/ME, NIT, Arunachal Pradesh                  | - Invitee         |
| 15. Dr. S. Maity, HoD/BAS, NIT, Arunachal Pradesh                  | - Invitee         |
| 16. Dr. P. K. Hui, HoD I/C/BT, NIT, Arunachal Pradesh              | - Invitee         |
| 17. Dr. A. Banerjee, HoD/EE, NIT, Arunachal Pradesh                | - Invitee         |
| 18. Dr. K. Sambyo, HoD/CSE, NIT, Arunachal Pradesh                 | - Invitee         |
| 19. Dr. Yaka Bullo, HoD/ECE, NIT, Arunachal Pradesh                | - Invitee         |

Member not present:

1. Prof. V. S. Moholkar, Professor, IIT Guwahati Member, could not attend the meeting due to pre-occupations.

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**Agenda Item: 21.01**

**Confirmation of the Minutes of 19<sup>th</sup> Meeting of the Senate held on 25/07/2019 and Action Taken Report**

Minutes of 20<sup>th</sup> Senate Meeting of NIT, Arunachal Pradesh were made and signed by members. As such, Minutes of 20<sup>th</sup> Senate was approved & Action Taken Report is placed in ANNEXURE 21.01.

**Decision: Noted & Approved.**

**Agenda Item: 21.02**

**Seeking Approval of Academic Calendar (Jan-June, 2020)**

Academic Calendar for the session Jan-June, 2020 is placed below:

Month	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January				1	2	3 End of winter vacation	4
	5	6 Start of Classes Registration for 2 <sup>nd</sup> & 4 <sup>th</sup> sem	7 Registration for 6 <sup>th</sup> sem	8 last date of regn. Without late fee, Registration for 8 <sup>th</sup> sem	9	10	11
	12	13	14 Last date of regn. With late fee	15 Makar Sankranti	16	17	18
	19	20	21	22	23	24	25
	26 Republic Day	27	28	29	30	31 Athletic Meet (Classes suspended)	
February							1 Athletic Meet (Classes suspended)

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		2Athletic Meet(Classes suspended)	3	4	5	6	7	8
		9	10	11	12	13	14	15
		16	17	18	19	20	21	22
		23	14	25	26 Nyokum	27	28	29 Mid Sem Exam
March	1	2 Mid Sem Exam	3 Mid Sem Exam	4 Mid Sem Exam	5 Mid Sem Exam	6	7	
	8	9	10 Holi	11	12	13	14	
	15	16	17	18	19	20Atulyam (Classes suspended)	21Atulyam (Classes suspended)	
	22	23	24	25	26	27	28	
	29	30	31					
April					1	2	3	4
	5	6 Mahavir Jayanti	7	8	9	10 Good Friday	11	
	12	13	14Vaisakhi/Bohag Bihu	15	16	17	18	
	19	20 Practical Exam	21 Last day of Teaching Practical Exam	22 Practical Exam	23 Practical Exam	24	25 End Sem Exam	
	26	27 End Sem Exam	28 End Sem Exam	29 End Sem Exam	30 End Sem Exam			
May							1 End Sem Exam	2 End Sem Exam
	3	4 End Sem Exam	5 End Sem Exam	6 End Sem Exam	7 Buddha PurnimaSummer vacation for	8	9	

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	10	11	12	13	14	15 Last date of Marks Submission	16 Result Moderation
	17 Result Moderation	18 Result Moderation	19 Result declaration	20 Result declaration	21 Summer vacation for faculty	22 Rgn for Summer course	23 Rgn for Summer course
	24	25 Eid - ul - Fitar	26 Start of Classes for Summer Course	27	28	29	30
	31						

June		1	2	3	4	5	6
	7	8	9 Mid sem of Summer Course	10 Mid sem of Summer Course	11 Mid sem of Summer Course	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25 End sem of Summer Course	26 End sem of Summer	27 End sem of Summer
	28	29 Grade submission	30 result Moderation				

July				1 Result declaration	2 Result declaration	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	

Total No of Classes	NIL	<b>13</b>	<b>13</b>	<b>12</b>	<b>14</b>	<b>13</b>	NIL
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**NOTE:**

1. Last date of Regn with late fee Rs. 500/- 9<sup>th</sup> to 15<sup>th</sup> January 2020.
2. The payment of fees online does not amount to registration, which must be done separately by the student in person at the institute.
3. No registration after the last date with late fee (January 15, 2020) will be permitted under any circumstances.
4. Start of classes of 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>& 8<sup>th</sup> semester for Jan-June, 2020 session – Jan 7, 2020.
5. Last date for received of application for summer course is 23<sup>rd</sup> May 2020
6. Summer vacation for faculty (except coordinators of summer courses) from 21<sup>st</sup> May 2020 to 15<sup>th</sup> July-2020.

**Decision: Noted & Approved.**

**Agenda**

**Item:  
21.03**

**Ratification of BOS approval for new PhD syllabus for ECE & CE department**

Department of CE& ECE has conducted BoS on 28.09.2019 and 31/10/19 respectively for new syllabus framing for PhD courses, the same is given below.



**NATIONAL INSTITUTE OF TECHNOLOGY**  
(Established by Ministry of Human Resource Development, Govt. of India)  
**UPIA, DIST. PAPUM PARE, ARUNACHAL PRADESH, Pin-791112**  
Website: [www.nitap.ac.in/academic/department/ECE](http://www.nitap.ac.in/academic/department/ECE)  
Email: [hodece@nitap.ac.in](mailto:hodece@nitap.ac.in)

**Ph. D Course work**

Sl. No.	Subject Name	Code	Credit
1	ADVANCED REINFORCED CONCRETE DESIGN	PHD070	3
2	ADVANCED STRUCTURAL ANALYSIS	PHD071	3
3	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	PHD072	3
4	STRUCTURAL DYNAMICS	PHD073	3
5	ADVANCED SOIL MECHANICS	PHD074	3
6	ADVANCED FOUNDATION ENGINEERING	PHD075	3
7	SUB SURFACE INVESTIGATION AND INSTRUMENTATION	PHD076	3
8	WATER SUPPLY ENGINEERING	PHD077	3
9	MUNICIPAL WASTEWATER TREATMENT	PHD080	3

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10	SOLID AND HAZARDOUS WASTE MANAGEMENT	PHD081	3
11	CONTAMINANT TRANSPORT AND MODELING	PHD082	3
12	HYDEOMETROLOGY AND RISK ANALYSIS	PHD083	3
13	STOCHASTIC GROUND WATER HYDROLOGY	PHD038	3
14	ERROR CONTROL CODES	PHD091	3
15	CHANNEL MODELLING FOR WIRELESS COMMUNICATION	PHD092	3
16	MOBILE ADHOC NETWORKING	PHD093	3
17	MOBILE COMMUNICATION	PHD094	3
18	IMAGE PROCESSING	PHD095	3
19	SPEECH SIGNAL PROCESSING AND CODING	PHD096	3
20	BIOMEDICAL SIGNAL PROCESSING	PHD097	3
21	INFORMATION THEORY AND CODING TECHNIQUES	PHD098	3
22	ANTENNAS AND PROPAGATION FOR WIRELESS COMMUNICATION	PHD099	3
23	ADVANCED TOPICS IN MACHINE LEARNING	PHD100	3
24	CONTROL SYSTEM FOR INDUSTRIAL AUTOMATION	PHD101	3

**PhD 070 ADVANCED REINFORCED CONCRETE DESIGN**

L	T	P	C
3	0	0	3

**Course Content:**

Deflections and crack width of Reinforced Concrete Beams and Slabs; Yield line theory of slabs; Inelastic Analysis of Reinforced Concrete Beams and Frames; Design of Shear Walls, Cast-in-Situ Beam-Column Joints, Deep Beams, Ribbed Slabs; Steel-concrete composite structure, Design of shear connectors, Design of Reinforced Concrete Members for Fire Resistance, Virendeel Girders, Concrete Trusses, Software applications.

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### Books Recommended:

1. Varghese P C "Advanced Reinforced Concrete Design" Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.
2. Krishna Raju N "Advanced Reinforced Concrete Design" CBS Publishers and Distributors, New Delhi, 1988.
3. Park R and Paulay T "Reinforced Concrete Structures" John Wiley and Sons, New York, 1975.
4. SP 208 "Examples for the Design of Structural Concrete with Strut – and – Tie Models" Editor: Karl – Heinz Reineck, American Concrete Institute, Michigan, 2003.
5. Leet, Kenneth M and Bernal D "Reinforced Concrete Design" McGraw Hill, London.
6. IS 456-2000 Plain and reinforced concrete (code of practice- fourth revision), BIS, New Delhi
7. IS 13920: Ductile detailing of reinforced concrete structure, BIS, New Delhi.

### PhD 071 ADVANCED STRUCTURAL ANALYSIS

L	T	P	C
3	0	0	3

### Course Content:

Basic concepts, Degree of static and kinematic indeterminacy, Matrix algebra, Solution of simultaneous equations by Gaussian Elimination, Flexibility and Stiffness Matrices, Application of Virtual Work and energy principles, System Approach: Development of stiffness matrix, Applications of stiffness method to continuous beams, trusses and frames. Effect of temperature, and pre-strain. Element Approach: Element stiffness, 2D truss element and beam element, Transformation matrix, Assembly of global stiffness matrix, Storage requirement of stiffness matrix, Application of stiffness method to beams, trusses and frames, Material and geometrical non-linearity, Software applications.

### Books Recommended:

1. Pandit G S and Gupta S P "Matrix Analysis of Structures" Tata McGraw Hill, New Delhi, 2003.
2. Gere W and Weaver J M "Matrix Analysis of Structures" CBS Publishers, New Delhi, 2002.
3. Rajasekaran S and Sankarasubramanian G "Computational Structural Mechanics" Prentice Hall India, New Delhi, 2001.
4. Vazirani V N and Ratwani M M "Advanced Theory OF structures and Matrix Method" Khanna Publishers, New Delhi, 1995.
5. Godbole P.N, Sonparote, Dhote RN - 'Matrix Method of Structural Analysis' I K Int. Publishing House- New Delhi, 2014.

Hibbeler – Structural Analysis, Pearson Edu. London, 2009

### PhD 072 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	C
3	0	0	3

### Course Content:

Behavior of buildings and structures during past earthquakes and lessons learnt, goals of earthquake resistant design. Linear static procedure for seismic load calculation, combination of gravity and seismic action. Multimodal and Multidirectional response spectrum analysis. Earthquake resistant measures at planning stage: Geotechnical and architectural considerations, irregularities, earthquake resistant measures in sloping roofs, staircase, foundations, General construction details, principals of earthquake resistant design – behaviour of concrete and steel, confined concrete, the capacity design method; Ductility design provisions, behaviour of masonry structures during earthquakes, analysis and behaviour of masonry infilled RC frames, earthquake resistant measures in masonry buildings.

**Books Recommended:**

1. Dowrick D J “Earthquake Resistant Design for Engineers and Architects” John Wiley and Sons, New York, 1987.
2. Dowrick D J “Earthquake Risk Reduction” John Wiley and Sons, New York, 2003.
3. Englekirk R E “Seismic Design of Reinforced and Pre-cast Concrete Buildings” John Wiley and Sons, New York, 2003.
4. Pauley T and Priestley M J N “Seismic Design of Reinforced Concrete and Masonry Buildings” John Wiley and Sons, New York, 1992.
5. Key D “Earthquake Design Practices for Buildings” Telford Publishers, London, 1990.
6. IS: 1893 – 2002 “Code of practice-Earthquake Resistant Design of Building”, BIS, New Delhi
7. IS: 4326 – 1993 “Code of practice-Earthquake Resistant Design and Construction of Buildings” (Second revision), BIS, New Delhi
8. IS: 13920 – 1993 “ Code of practice-Ductile Detailing of RCC Structures subjected to Seismic Force , BIS, New Delhi

**PhD 073 STRUCTURAL DYNAMICS**

L	T	P	C
3	0	0	3

**Course Content:**

Introduction to dynamic loading and its effects on structures, Degrees of freedom and constraints, Equations of motion, Newton’s Law and De Alembert’s Principle, Response of single degree of freedom systems to initial conditions, Response to harmonic excitation, Dynamic amplification factor, Transmissibility, Base Isolation, Response to non harmonic excitations such as impulse, step loading and blast loading, Duhamel’s Integral, Earthquake response analysis, Response spectrum, Principles of vibration measuring equipments, Estimation of dynamic characteristics through experimental investigations, Multi degree of freedom systems, Matrix equations and eigenvalue problem, Orthogonality of mode shapes, Mode superposition method for seismic analysis. MATLAB application in Structural Dynamics.

**Books Recommended:**

1. Clough R W, Penzien J, “Dynamics of Structures”, McGraw-Hill, Inc, New York, 1991.
2. Chopra A K “Dynamics of Structures: Theory and Applications to Earthquake Engineering” Prentice Hall (India) Private Ltd, New Delhi, 2000.
3. Roy Creig Jr. “Structural Dynamics: An Introduction to Computer Methods”, John Wiley & Sons, New York, 1981.

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4. James M L, Smith G M, Wolford J C and Whaley P W "Vibration of Mechanical and Structural Systems: With Microcomputer Applications", Happer & Row, Publishers, New York, 1989.
5. Daniel J. Inman, "Engineering Vibration", Fourth Edition, Pearson, London, 2013

**PHD 074 ADVANCED SOIL MECHANICS**

L	T	P	C
3	1	0	4

**Course Content:**

Introduction to stress-strain behavior of soils; Mohr Circle of Stress; Principal Stresses; Stress and strain invariants; plane strain, plane stress and axisymmetric conditions.

Shear strength of cohesive and cohesionless soils; drained and undrained shear strength of soils, Significance of pore pressure parameters; Determination of shear strength; Interpretation of triaxial test results; Influence of stress history.

Stress path; Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Critical state soil mechanics; Concept of yielding and failure surface; Critical state parameters; Critical state for normally consolidated and overconsolidated soil considering drained and undrained conditions; Significance of Roscoe and Hvorslev state boundary surface; Complete state boundary surface; drained and undrained plane. Original Cam clay and Modified cam-clay model.

Elastic and plastic deformations: yielding and hardening; yield criteria and plastic flow rule.

**Textbooks/References**

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to critical soil mechanics, McGraw Hill, 1978.
2. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.
3. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
4. Parry, R.H.G., Mohr Circle, Stress Paths and Geotechnics, CRC Press, 2004
5. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
6. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.
7. Budhu, M., Soil Mechanics and Foundation, 3<sup>rd</sup> Edition, Wiley, 2010
8. Yu, M.-H. and Li, J.C., Computational Plasticity, Zhejiang University Press, Springer, 2012
9. Potts, D.M. and Zdrakovic, L., Finite element Analysis in Geotechnical Engineering, Theory and Applications; Vol. I and II, Thomas Telford, USA, 1999

**PHD 075 ADVANCED FOUNDATION ENGINEERING**

L	T	P	C
3	0	0	3

**Course Content:**

Classification and choice of foundations; Shallow foundations – bearing capacity theories and their modification under special conditions, bearing capacity and settlement analysis through direct and indirect methods; Design of combined, mat and annular foundations;

Pile foundations – estimation of load capacity and settlement/deformation, design of single vertical and

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batter piles subjected to different loads (compressive, uplift and/or lateral), design of pile groups, negative skin friction; Other deep foundations – drilled pier, caisson and well foundations;  
 Special foundations – foundations on collapsible and expansive soils, foundations for chimneys and tall structures, foundations on very soft soils, piled raft foundations, large diameter monopiles.

**Textbooks/References**

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International, 5<sup>th</sup> Edn, 2012.
2. Chen, F.H., Foundations on Expansive Soils, 2nd edition, Elsevier Science Publishers, 1988.
3. Coduto, D.P, Foundation Design-Principles and Practices, Pearson International Edition, 2013.
4. Das B.M., Shallow Foundations: Bearing Capacity and Settlement, CRC Press, 2<sup>nd</sup> Edn., 2009.
5. Hemsley, J.A., Design Applications of Raft Foundations, Thomas Telford, 1<sup>st</sup> Edn., 2000.
6. Kurian, N.P., Design of Foundation Systems - Principles and Practices, Narosa Publishing House, 3<sup>rd</sup> Edn., 2006.
7. Kurian, N.P., Modern Foundation, Tata McGraw Hill, 1982.
8. Murthy V.N.S., Advanced Foundation Engineering, Geotechnical Engineering Series, CBS Publishers, 2<sup>nd</sup> Edn., 2010.
9. Prakash, S. and Sharma, H.D., Pile Foundations in Engineering Practice, John Wiley & Sons Inc., 1990.
10. Tomlinson M.J., Pile Design and Construction Practice, CRC Press, 5<sup>th</sup> Edn., 2007.
11. Tomlinson, M.J., Foundation Design and Construction, John Wiley and Sons, 7<sup>th</sup> Edn., 2003.
12. Reese, L. and van Impe, W., Single Piles and Pile Groups under Lateral Loading, Taylor and Francis, 2<sup>nd</sup> Edn., 2011.
13. Zeevaert, L., Foundation Engineering for Difficult Subsoil Conditions, van Nostrand Reinhold Company, 1974.

**PHD 076 SUB SURFACE INVESTIGATION AND INSTRUMENTATION**

L	T	P	C
3	0	0	3

**Course Content:**

Problems and phases of foundation investigations. Geophysical, sounding, drilling and accessible explorations. Sample requirements, sampling methods and equipment. Handling, preservation and transportation of samples. Sample preparation, laboratory tests, analysis of results and interpretation, importance of in-situ testing. Performing various in situ tests. Precautions and interpretation. Field Instrumentation; Investigation below sea/river bed; offshore investigation; Site evaluation and reporting.

**Textbooks/References**

1. Bowles, J.E., Physical and Geotechnical Properties of Soil, McGraw-Hill Book Company, 1985.
2. Bowles, J.E, Foundation Analysis and Design, McGraw-Hill International edition, 1997.
3. Dunncliff, J. and Green, G.E, Geotechnical Instrumentation for Monitoring Field Performance, John Wiley & Sons, 1982.
4. Gopal Ranjan and Rao, A.S.R, Basic and Applied Soil Mechanics, Wiley Eastern Limited, 1991.
5. Lunne, T., Robertson, P.K. and Powell, J.J.M, Cone Penetration Testing in Geotechnical Practice, Blackie Academic & Professional, 1997.
6. Compendium of Indian Standards on Soil Engineering Parts 1 and II 1987 - 1988.
7. Fang, H.-Y., Foundation Engineering Handbook, 2<sup>nd</sup> Edition, Springer, 1991.

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## PhD 077: WATER SUPPLY ENGINEERING

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3	0	1	4

### Course Content:

Components of water supply system; Water uses and demand estimation, Design period, population data and flow rates for water supply system; factor affecting water consumption and variation in demand; Design of water distribution systems, methods of analysis for optimal distribution network design; types of reservoirs and design parameters and methods design of water pumping stations.

Physical and chemical quality of surface and sub-surface water; theory and design and physicochemical unit operation: Aeration and gas transfer, sedimentation, coagulation, flocculation, filtration, water softening, Adsorption: physical versus chemical adsorption, factors influencing adsorption, Adsorption isotherms; Ion exchange, disinfection.

Laboratory: Works related with Water and Wastewater Quality Parameters.

### Text books:

1. Garg, S.K, Water Supply Engineering, Khanna publication, 2001
2. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., Environmental Engineering, McGraw-Hill International Ed., 1985.
3. McGhee, T.J., water supply and sewerage, McGraw Hill International, 1991.

### Reference books:

1. Central public health and Environmental Engineering Organization, Manual on Water Supply and Treatment, 2<sup>nd</sup> Edition, Ministry of Urban Development, New Delhi, December, 1991.
2. AWWA/ ASCE, Water Treatment Plant Design, 3<sup>rd</sup> Edition- McGraw Hill, 1998.
3. Quasim, S.R., Motley E.M. and Zhu, G., Water Works Engineering- Planning, Design and Operation, Prentice Hall, 2000.

## PhD 080: MUNICIPAL WASTEWATER TREATMENT

L	T	P	C
3	0	0	3

### Course Content:

Characterization of municipal wastewater (sewage): microbiological concepts, cells, classification and characteristics of living organisms, reproduction, metabolism – basic metabolic models, microbial growth kinetics; Chemistry of carbohydrates, proteins, fats and lipids; Theory and design of unit operations and processes: screening, grit chamber, equalization, sedimentation, floatation, aerobic suspended growth systems – activated sludge processes and its modifications, ponds and lagoons; aerobic attached growth systems; anaerobic suspended and attached systems; Biological nutrient removal; Sequential Batch Reactors; Membrane based biological reactors, Theory and design of sludge treatment; Wastewater disposal systems.

**Text books:**

1. Metcalf and Eddy Inc., Wastewater Engineering – Treatment and Reuse, Tata McGraw Hill India, 2003, 4th Edition.
2. Pelczar, M. J. (Jr), Chan, E C S and Krief, N. R., Microbiology, 5 th Ed., McGraw-Hill, 1996.
3. Henze, M., Harremoes, P., Jansen, J. C. and Arvin, E., Wastewater Treatment: Biological and Chemical Processes, 3 rd Ed., Springer Verlag, 2002
4. Garg, S.K., Sewage Disposal and air pollution Engineering, Khanna Publication, 2005.

**Reference books:**

1. Central public health and Environmental Engineering Organization, Manual On Sewerage and Sewage Treatment, 2<sup>nd</sup> Ed, Ministry of Urban Development, New Delhi, December 1993.
2. Arceivala, S. J., Wastewater Treatment for Pollution Control, Tata McGraw Hill, 1999
3. Benefield, L. D. and Randall, C. W., Biological Principles in Wastewater Treatment, PrenticeHall, 1980.
4. Heritage, J., Evans, E. G. V. and Killington, R. A., Introductory Microbiology, Cambridge Univ. Press, 1996.
5. Grady, C. P. L., Daigger, G. T. and Lim, H. C., Biological Wastewater Treatment, Marcel Dekker, Inc., New York, 2 nd Edition, 1999.

**PhD 081: SOLID AND HAZARDOUS WASTE MANAGEMENT**

L	T	P	C
3	0	0	3

**Course Content:**

Solid Waste: sources and types, characterization, Functional elements of municipal solid waste: generation, on-site storage, primary and secondary collection, transfer and transport, solid waste transformation/treatment (Incineration, composting, anaerobic digestion), Sanitary landfills; Legislation in solid waste; integrated solid waste management.

Hazardous waste: definition, generation, classification; Risk assessment; Environmental Legislation; Waste minimization and resource recovery; Storage and Transportation of Hazardous wastes; processing and treatment; Physical, Chemical, Thermal and Biological processes; Hazardous waste disposal.

**Text Books:**

1. Central public health and Environmental Engineering Organization, Manual On Solid Waste Management, 2016, Ministry of Urban Development, New Delhi.
2. Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993.
3. Vesilind, P. A., Worrel, W. A. and Reinhart, D. R., Solid Waste Engineering, Thomson Brooks/Cole, 1<sup>st</sup> Ed., 2002.
4. LaGrega, M. D., Buckingham, P. L. and Evans, J. C., Hazardous Waste Management, 2<sup>nd</sup> Ed., McGraw Hill, 2001.

**Reference Books:**

1. Bagchi, A., Design, Construction and Monitoring of Landfills, Wiley Interscience, 1994.

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2. Haas, C. N. and Vamos, R. J., Hazardous and Industrial Waste Treatment, Prentice Hall, 1995.
3. Martin, E.J. and Johnson, J.H., Hazardous Waste Management Engineering, Van Nostrand, 1987.
4. Wentz, C. A, Hazardous Waste Management, 2nd Ed., McGraw Hill, 1995.
5. Lewandowski, G.A. and DeFilippi, L.J., Biological Treatment of Hazardous Wastes, John Wiley & Sons, INC., 1998.
6. Kuhre, W. L., Practical Management of Chemicals and Hazardous Wastes: An Environmental and Safety Professional's Guide, Prentice Hall, 1995.

### PHD 038 STOCHASTIC GROUND WATER HYDROLOGY

L	T	P	C
3	0	0	3

#### Course Content:

Occurrence of ground water: Groundwater in hydrological cycle, Properties of rocks and water bearing formations affecting ground water flow, Vertical distribution of ground water, Ground water potential and its exploitation in India.

Groundwater movement: Darcy's law, Permeability and its determination, Flow rates and directions of flow of ground water, Dispersion of tracers in ground water, Unsaturated flows, General equations governing steady/unsteady flow through confined and unconfined aquifers.

Hydraulics of water wells: Flow in confined aquifers towards wells in steady and unsteady state. Flow through leaky or semi-confined aquifers into wells, Dupuit's assumption for unconfined aquifers, Steady and unsteady flows into wells, Theis, Jacob's and Chow's methods of solution of unsteady flows, Method of superposition in groundwater flow-method of images, Solutions of flow towards wells near a recharge boundary or impermeable boundary, Use of observation wells, Multiple well systems, Partially penetrating wells.

Fundamentals of probability and statistics: concepts of conditional probability, random variables and their transformations, concepts of moments and quantiles, commonly used probability distribution functions, principles of hypotheses testing; principles of Monte Carlo simulation and estimation theory; methods of maximum likelihood and least squares minimization; theory of random processes, estimation of linear static systems, random fields

Stochastic hydrologic models – stochastic-dynamic systems; Kalman filter and its applications in hydrologic real-time forecasting, purely random stochastic models, first order Markov process, first order Markov process with periodicity.

#### BOOKS

1. Todd, D.K., and Mays, L. W., Groundwater Hydrology, John Wiley & Sons, Singapore, 2011.
2. Bear, J., Dynamics of Fluids in porous Media, Dover Publications, 1972.
3. Mackay, R. & Riley, M., Groundwater Modeling, in *An Introduction to Water Quality Modelling* Second Edition, Ed: A. James, Wiley Publishers, 1992.
4. C. T. Haan, Statistical Methods in Hydrology, Wiley-Blackwell; 2nd edition, 2002

#### REFERENCE

1. M. Shahin, H. J. L.vanOorschot, and S. J. de Lange, Statistical Analysis in Water Resources Engineering, Aa-Balkema, Rotterdam, Brookfield, 1993
2. Zhang, Dongxiao, Stochastic Methods for Flow in Porous Media, Academic Press, 2002.
3. Fetter, C.W., Contaminant Hydrogeology, Prentice Hall, 1999.
4. Groundwater journal, Wiley Online Library

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## PHD 082 CONTAMINANT TRANSPORT AND MODELING

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### Course Content:

Water quality parameters: Concepts & Analysis Impurities and water quality characterisation; Physical, Chemical and Biological parameters; Analytical estimation;

Movement: Movement of pollutants in aquatic environment, Water quality issues; Transport and transformation processes in surface and groundwater systems; water quality modeling.

Surface water quality modeling: Steady state conditions- plug flow & mixed flow systems. Transport and variation of dissolved oxygen- Streeter-Phelps equation and modeling of chemical parameters- modeling ph, toxics, metals.(oxygen sag, BOD, Henry's law, Ideal gas law, DO saturation, BOD model).

Groundwater contamination: Sources & type, Contaminant transport mechanisms: Advection, Diffusion & dispersion, Mass transport equations, one & two-dimensional modeling. Sorption & other chemical reactions: factors affecting sorption, Sorption isotherms, Sorption effect on fate & transport of pollutants, Estimation of sorption. Biodegradation reactions & kinetics: biological transformations, microbial dynamics, kinetics of biodegradation Nonaqueous-phase liquids: Types of NAPLs, general processes, NAPL transport computational methods. Groundwater remediation and design: Remedial alternatives, source control, hydraulic controls, bioremediation, soil vapor extraction systems, remediating NAPL sites, emerging technologies

Transport and transformation of contaminants in groundwater - Formulation of the governing equations and initial and boundary conditions, modeling, Advection, Diffusion and Advection-Diffusion equations .Convergence, stability and consistency of finite difference schemes. Modeling using MODFLOW and MT3D.

### BOOKS

1. Rifai & Newell, Ground Water Contamination, Transport and Remediation by Bedient, , PTR Prentice Hall
2. D.K. Todd, Groundwater Hydrology, John Wiley & Sons
3. Fetter C.W., "Contaminant Hydrogeology", Prentice Hall, 1999

### REFERENCE

1. VedatBatu, Applied Flow and Solute Transport Modeling in Aquifers, Taylor and Francis/ CRC Press, 2006
2. F. W. Schwartz and H. Zhang, Fundamentals of Groundwater, John Wiley & Sons, Inc., 2003.

## PHD 083 HYDEOMETROLOGY AND RISK ANALYSIS

L	T	P	C
3	0	0	3

### Course Content:

Introduction: Hydro-climatology: climate system; climate, weather and climate; overview of earth's atmosphere; vertical structure of atmosphere; radiation and temperature; laws of radiation; heatbalance of earth atmosphere system; random temperature variation; modeling vertical variation in air temperature; temporal variation of air temperature; temperature change in soil; thermal time and temperature extremes..

Hydrologic cycle: introduction; global water balance; cycling of water on land, a simple water balance

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model; climate variables affecting precipitation, precipitation and weather, humidity, vapor pressure, forms of precipitation, types of precipitation; cloud; atmospheric stability; monsoon; wind pattern in India; global wind circulation; Indian summer monsoon rainfall.

Climate variability: floods, droughts, drought indicators, heat waves, climate extremes. steps of risk characterization - hazard identification, exposure assessment, vulnerability analysis, risk mapping, risk characterization to natural hazards, risk assessment as a distributed process.

Climate change: introduction; causes of climate change; modeling of climate change, global climate models, general circulation models, downscaling; IPCC scenarios; commonly used statistical methods in hydro-climatology: trend analysis; empirical orthogonal functions, principal component analysis; canonical correlation; statistical downscaling with regression.

Remote Sensing: Concepts and foundations of remote sensing- Energy sources and radiation principles- Energy interactions in the atmosphere – Energy interaction with earth surface features - Spectral reflectance of vegetation, soil and water - Atmospheric influence on spectral response patterns

Concepts of GIS: GIS - Definition, Spatial and attribute data, Components of GIS, DBMS – Geospatial data representation (Raster, Vector) -Sources of GIS data – Data input - Raster geospatial data analysis - Output functions of raster geoprocessing – Vector GIS analysis functions - Vector geo-processing output functions

## BOOKS

1. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 1995.
2. Linsley , Kohler &Paulhus, Engineering Hydrology, McGraw Hill.
3. Thomas. M. Lillesand, Ralph. W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image Interpretation , John Wiley and Sons, Inc., Sixth Edition, 2011
4. K. McGuffie, and A. Henderson-Sellers, The Climate Modelling Primer 4th edition, Wiley Blackwell, 2014.

## Reference

1. M. L. Shelton, Hydroclimatology: Perspectives and Applications, Cambridge University Press, 2009.
2. G. S. Campbell, and J. M. Norman, An Introduction to Environmental Biophysics, Springer, 2013
3. Journal of hydrology, ScienceDirect

## PHD091 Error Control Codes

L	T	P	C
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## Course Content

Basic Digital Communication, Signal Detection, Memoryless Channels, Hamming Codes, Overview of Information Theory, Linear Algebra, Rings, Number Theory and Algebra (Divisibility, Euclidean Algorithm, Sugiyama Algorithm, Congruences, f function, Chinese Remainder Theorem, Fields over R and C, Galois Fields, Galois Field Arithmetic, Irreducible and Primitive Polynomials, Krawtchouk Polynomials).

Linear Block Codes-Generator Matrix, Parity Check Matrix, Dual Codes, Weight Distribution, Hamming Codes and their Dual, Erasure Decoding; Cyclic Codes-Cyclic Encoding, Syndrome Decoding, Binary CRC Codes; BCH, Reed Solomon Codes, Goppa Codes, Peterson's Algorithm, Berlekamp –Massey Algorithm, Forney's Algorithm

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Welch –Berlekamp Key Equation, Guruswami –Sudan Decoding Algorithm and Soft RS decoding, Hadamard Matrices and Codes, Reed Muller Codes, Quadratic Residue Codes, Golay Codes; Gilbert – Varshamov Bound, Plotkin Bound, Griesmer Bound, Linear Programming and Related Bounds, McEliece –Rodemich –Rumsey –Welch Bound; Bursty Channels, Interleavers and Concatenation; Soft Decision Decoding Algorithms;

Convolutional Codes, Viterbi Algorithm, Error Analysis, Puncturing, Suboptimal decoding algorithm for Convolutional codes, convolutional codes as block codes, Trellis representation of Block and Cyclic Codes, Trellis Coded Modulation; Turbo Codes –Encoding parallel concatenated codes, decoding algorithms, Error Floor and Weight Distribution; Low Density Parity Check Codes –Construction, Tanner graphs, Decoding. Space Time Coding –Fading Channels, Rayleigh Fading, MIMO Channel, Space Time Block Codes, Space –Time Trellis Codes.

**Text/References:**

1. T. K. Moon, Error Correction Coding: Mathematical Methods and Algorithms, Wiley, 2006.
2. W. C. Huffman and V. Pless, Fundamentals of Error – Correcting Codes, CUP, 2003.
3. S. Lin and D. J. Costello, Error Control Coding: Fundamentals and Application, 1983.
4. R. H. Morelos-Zaragoza, The Art of Error Correcting Codes, Wiley, 2002

**PHD092Channel Modelling For Wireless Communication**

L	T	P	C
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**Course Content**

*Propagation Mechanisms:* Free Space Propagation, Reflection and Transmission, Diffraction, Scattering on Rough Surfaces, Wave Guiding, Statistical Description of Wireless Channels - The Time-Invariant Two-Path Model, Time-Variant Two-Path Model, Small-Scale Fading Without Line-of-Sight, Small-Scale Fading With Line-of-Sight, Doppler Spectra, Level Crossing Rate and Random FM, Large-Scale Fading.

*Wideband Channel Characterization:* Narrowband vs. Wideband Systems, System-Theoretic Description of Propagation Channels, the WSSUS Model, Description Methods for Time Dispersion, Description Methods for Angular Dispersion

*Channel Models:* Narrowband Models, Wideband Models, Spatial Models, Deterministic Models, Models for Ultra-Wideband Channels, Channel Sounding - Time-Domain & Frequency-Domain Methods.

*Antenna aspects in wireless systems:* Requirements for Antennas in Mobile Radio, Antennas for Mobile Stations, Antennas for Base Stations, Aspects of Multiple Antenna Systems.

**Text/References:**

1. Andreas F. Molisch, Wiley Wireless Communication, 2010.
2. Andrea Goldsmith Cambridge University Press, Wireless Communications, 2005.
3. Theodore Rappaport, Prentice Hall, Wireless Communication: Principles and Practice, 2002.

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## PHD093 Mobile Adhoc Networking

L	T	P	C
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### Course Content

*Introduction to Adhoc networks:* Definition, Characteristics Features, Application, Characteristics of Wireless Channel

*Adhoc Mobility Models:* Indoor and Outdoor Models.

*MAC Protocols:* Design Issues, Goals and Classification. Contention Based Protocols –With Reservation, Scheduling Algorithms, Protocols Using Direction Antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

*Routing Protocols:* Design Issues, Goals and Classification. Proactive vs. Reactive Routing, Uncast Routing Algorithms, Multicast Routing Hierarchical Routing, Quos Aware Routing.

*End-End Delivery and Security:* Transports Layer: Issues in Designing-Transport Layer Classification, Adhoc Transport Protocols. Security Issues in Adhoc Network: Issues and Challenges, Network Security Attacks, Secure Routing Protocols.

*Cross Layer Design and Integration of Adhoc network :* Cross Layer Design: Need For Cross Layer Design, Cross Layer Optimization, Parameter Optimizations, Techniques, Cross Layer Cautionary Perspective. Integration of Adhoc with Mobile IP Networks. Mesh Networks, Vehicular Area Networks.

### Texts/ References:

1. C K Toh, *Ad-hoc mobile wireless network –protocols and systems*, prentice hall, 2007.
2. Siva Ram Murthy, *Ad-hoc wireless networks –architecture and protocols*, Addison-Wesley, 2006.
3. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic, *Mobile Ad Hoc Networking*, Wiley-IEEE Press, 2004.
4. Edgar H. Callaway, *Wireless sensor networks: architecture and protocols*, Auerbach publications, 2008.
5. Azzedine Boukerche, *Algorithms and Protocols for Wireless and Mobile Ad Hoc Networks*, Wiley, 2009.
6. Yi Pan, Yang Xiao, *Ad Hoc and Sensor Networks*, Nova Science Publishers, 2005.
7. Hai Liu, Xiaowen Chu, Yiu-Wing Leung, *Ad Hoc and Sensor Wireless Networks: Architectures, Algorithms and Protocols*, Bentham Science, 2009.

## PHD094 Mobile Communication

L	T	P	C
3	0	0	3

### Course Contents:

Introduction: Evolution of Mobile Radio Communication; Different Generations Of Wireless Communication And Their Technical Specifications;

Cellular Concept: Frequency Reuse, Channel Assignment, Handoff, Interference, Improving System Capacity and Cell Coverage, Radio Trunking;

Mobile Radio Propagation: Free Space Propagation, Reflection, Diffraction, Scattering, Link Budget Design;

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Fading: Multipath Propagation, Doppler Shift, Impulse Response Model, Multipath Parameters, Statistical Models For Multipath Propagation;  
 Mitigation of Fading Effects: Equalization, Diversity, Channel Coding;  
 Transmitter and Receiver Techniques: Modulation Techniques, Line Coding, Pulse Shaping, OFDM;  
 Multiple Access: FDMA, TDMA, SSMA, SDMA, OFDMA

**Texts/References:**

1. T. S. Rappaport, *Wireless Communications: Principles and Practice*, Pearson Education, 2010.
2. S. Haykin and M. Moher, *Modern Wireless Communications*, Pearson Education, 2011.
3. W. H. Tranter et. al., *Principles of Communication Systems Simulation with Wireless Applications*, Pearson Education, 2004.
4. A. Mitra, *Lecture Notes on Mobile Communication[online]*, QIP Section, IIT Guwahati, 2009.

**PHD095 Image Processing**

L	T	P	C
3	0	0	3

**Course Contents:**

*Introduction:* Human Visual System and Image Perception; Monochrome and Colour Vision Models; Image Acquisition and Display: Video I/O Devices; Standard Video Formats; Image Digitization, Display And Storage; 2-D Signals And Systems;  
 Image Transforms: 2D-DFT, DCT, KLT, Harr Transform And Discrete Wavelet Transform;  
*Image Enhancement:* Histogram Processing, Spatial-Filtering, Frequency-Domain Filtering;  
*Image Restoration:* Linear Degradation Model, Inverse Filtering, Wiener Filtering; Image Compression: Lossy and Lossless Compression, Entropy Coding, Transform Coding, Sub Band Coding;  
 Image Compression Standards: Video Compression- Motion Compensation, Video Compression Standards;  
 Image Analysis: Edge and Line Detection, Segmentation, Feature Extraction, Classification; Image Texture Analysis;  
 Morphological Image Processing: Binary Morphology- Erosion, Dilation, Opening And Closing Operations, Applications, Basic Grayscale Morphology Operations;  
 Colour Image Processing: Colour Models and Colour Image Processing, Image

**Texts/References:**

1. A. K. Jain, *Fundamentals of Digital Image processing*, Pearson Education, 2009.
2. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Pearson Education, 2008.
3. R. C. Gonzalez, R. E. Woods and S. L. Eddins, *Digital Image Processing using MATLAB*, 4. Pearson Education, 2004.
5. W. K. Pratt, *Digital Image Processing*, John Wiley & Sons, 2006.
6. S. Ahmed, *Image Processing*, McGraw -Hill, 1994.
7. S. J. Solari, *Digital Video and Audio Compression*, McGraw-Hill, 1997

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## PHD096 Speech Signal Processing and Coding

L	T	P	C
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### Course Contents:

*Introduction:* Speech Production And Perception, Information Sources In Speech, Linguistic Aspect Of Speech, Acoustic And Articulatory Phonetics, Nature Of Speech, Models For Speech Analysis And Perception;

*Short-Term Processing:* Time, Frequency and Time-Frequency Analysis;

*Short-Term Fourier Transform (STFT):* Overview of Fourier Representation, Non-Stationary Signals, Development of STFT, Transform and Filter-Bank Views Of STFT;

*Cesprum Analysis:* Basis and Development, Delta, Delta-Delta and Mel-Cepstrum, Homomorphic Signal Processing, Real and Complex Cepstrum;

*Linear Prediction (LP) Analysis:* Basis And Development, Levinson-Durbin's Method, Normalized Error, LP Spectrum, LP Cepstrum, LP Residual;

*Sinusoidal Analysis:* Basis and Development Phase Unwrapping, Sinusoidal Analysis And Synthesis Of Speech;

*Speech Coding:* Need and Parameters, Classification, Waveform Coders, Speech-Specific Coders, GSM, CDMA and Other Mobile Coders, Coding Standard.

*Applications:* Pitch Extraction, Spectral Analysis.

### Texts/References:

1. L. R. Rabiner and R. W. Schafer, *Theory and Applications of Digital Speech Processing*, Prentice-Hall Inc., 2011

2. J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis, *Discrete-Time Processing of Speech Signals*, Wiley-IEEE Press, NY, USA, 2000.

3. D. O'Shaughnessy, *Speech Communications: Human and Machine, Second Edition*, University Press, 2005.

4. T. F. Quatieri, "Discrete time processing of speech signals", Pearson Education, 2005.

5. L. R. Rabiner, B. H. Jhuang and B. Yegnanarayana, "Fundamentals of speech recognition", Pearson Education, 2009.

## PHD097 Biomedical Signal Processing

L	T	P	C
3	0	0	3

### Course Contents:

Sources of Bioelectric Potential, Resting Potential, Action Potential, Propagation of Action Potentials in Nerves; Rhythmic Excitation of Heart; *ECG*: Pre-Processing, Waveform Recognition, Morphological Studies and Rhythm Analysis, Automated Diagnosis Based on Decision Theory, *ECG* Compression, Evoked Potential Estimation.

*EEG*: Evoked Responses, Averaging Techniques, Pattern Recognition of Alpha, Beta, Theta And Delta Waves In *EEG* Waves, Sleep Stages, Epilepsy Detection.

*EMG*: Wave Pattern Studies, Biofeedback Application of Signal Processing Techniques Such as Linear Prediction, Lattice-Filtering & Adaptive Signal Processing for Extraction of Physiological Parameters;

*Wavelets & Time Frequency Models*: Introduction, Their Applications to Heart Sounds, Fetal *ECG* &

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Vesicular Sound Signals;

Speech Production Model, Inverse Filtering Techniques for Extraction of Vocal Tract Parameters, Glottal Inverse Filtering; Electroglottographic Signals; Signal Processing Techniques for Detection of Pathologies in Speech Production System; Speech Synthesis and Speech Recognition in Diagnostic and Therapeutic Applications; Medical Imaging Techniques: CT Scan, Ultrasound, NMR and PET.

**Texts/References:**

1. E.N. Bruce, *Biomedical Signal Processing and Signal Modelling*, John Wiley and Sons, 2001.
2. W. J. Tompkins, ed., *Biomedical Signal Processing*; Prentice Hall, 1995.
3. M. Akay: *Wavelets and Time frequency methods for Biomedical signal Processing*; IEEE Press, 1997.
4. L. R. Rabiner and R. W. Schafer, *Theory and Applications of Digital Speech Processing*, Prentice-Hall Inc., 2011
5. A. C. Guyton: *Human Physiology*; Prism International, 2013.
6. Rangaraj M. Rangayyan, *Biomedical Signal Analysis*, Wiley Publication, 2016
7. Ervin Sejdic, Tiago H. Falk, *Signal Processing and Machine Learning for Biomedical Big Data*, CRC Press, 2018

**PHD098 Information Theory and Coding Techniques**

L	T	P	C
3	0	0	3

**Course Contents:**

*Information Theory:* Information – Entropy, Information Rate, Classification of Codes, Kraft Mcmillan Inequality, Source Coding Theorem, Shannon-Fano Coding, Huffman Coding, Extended Huffman Coding - Joint and Conditional Entropies, Mutual Information, Discrete Memoryless Channels, Bsc, Bec Channel Capacity, Shannon Limit.

*Block Code:* Definitions and Principles: Hamming Weight, Hamming Distance, Minimum Distance Decoding - Single Parity Codes, Hamming Codes, Repetition Codes; Linear Block Codes, Cyclic Codes - Syndrome Calculation, Encoder and Decoder, Crc.

*Convolutional Codes:* Convolutional Codes – Code Tree, Trellis, State Diagram, Encoding, Decoding, Sequential Search and Viterbi Algorithm; Principle of Turbo Coding.

*Source Coding:* Text: Adaptive Huffman Coding, Arithmetic Coding, Lzw Algorithm; Audio: Perceptual Coding, Masking Techniques, Psychoacoustic Model, Meg Audio Layers I,II,III, Dolby Ac3; Speech: Channel Vocoder, Linear Predictive Coding.

*Image and Video:* Image And Video Formats – Gif, Tiff, Sif, Cif, Qcif, Image Compression: Read, Jpeg, Video Compression: Principles- I, B, P Frames, Motion Estimation, Motion Compensation, H.261, Mpeg Standard

**Text/References:**

1. G. A. Jones and J. M. Jones, *Information and Coding Theory*, Springer, 2000.
2. J. H. van Lint, *Introduction to Coding Theory*, Springer, 1999.
3. Thomas M Cover, *Elements of Information Theory*, Wiley, 2013.
4. R. W. Hamming, *Coding and Information Theory*, Prentice Hall, 1986.
5. R. E. Blahut, *Principles and Practice of Information Theory*, Addison-Wesley, 1987.

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## PHD099 Antennas and Propagation for Wireless Communication

L	T	P	C
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### Course Contents:

Review Of Antenna Fundamentals: Concept of Vector Potential, Modification for Time Varying Retarded Case, Fields Associated With Hertzian Dipole, Radiation Resistance of Elementary Dipole With Linear Current Distribution, Radiation From Half-Wave Dipole And Quarter –Wave Monopole, Use Of Capacity Hat And Loading Coil For Short Antennas, Radiation Intensity, Directives Gain, Directivity, Power Gain.

*Loop Antennas:* Radiation from Small Loop and Its Radiation Resistance. Antenna Arrays: Expression for Electric Field From Two And Three Element Arrays. Uniform Linear Array. Method of Pattern Multiplication. Binomial Array. Use of Method of Images for Antennas above Ground

*Wideband Antennas:* Radiation from A Traveling Wave on a Wire, Rhombic Antenna, Coupled Antennas, Yagi Antennas, Log Periodic Antenna. Aperture and Lens Antennas, Radiation from the Open End of a Coaxial Line, Method of Feeding Slot Antennas.

*Propagation in Wireless Communication:* Ground Wave, Space Wave and Sky Wave Propagation. Sky Wave Propagation: Structure of the Ionosphere. Effective Dielectric Constant of Ionized Region. Mechanism of Refraction. Refractive Index. Critical Frequency. Skip Distance. Effect of Earth's Magnetic Field. Energy Loss in The Ionosphere Due To Collisions. Maximum Usable Frequency. Fading and Diversity Reception. Space Wave Propagation: Reflection from Ground for Vertically and Horizontally Polarized Waves. Ground Wave Propagation: Attenuation Characteristics for Ground Wave Propagation. Calculation of Field Strength At A Distance.

### Text/References:

1. Anil Pandey, *Practical Microstrip and Printed Antenna Design*, ArtTech House, 2019
2. John D. Kraus and Ronald R. Marhefka, *Antennas*, Tata McGraw-Hill Book Company, 2002
3. R.E. Collins, *Antennas and Radio Propagation*, McGraw-Hill, 1987
4. Ballany, *Antenna Theory*, John Wiley & Sons, Second Edition, 2003

## PHD100 Advanced Topics in Machine Learning

L	T	P	C
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### Course Contents

Kernel Methods: Review of SVM, Classification and Regression Using SVM, Properties of Kernels, Non-Mercer Kernels, Kernel Selection, Multiple Kernel Learning, Kernel PCA;  
Probabilistic Graphical Models: Bayesian Networks, Undirected Models, Bayesian Learning, Structure Learning, Inference on Graphical Models, Exponential Families;

*Deep Learning:* Review of Multi-Layer Perceptrons, Backpropagation Algorithms, Stochastic Gradient Descent, Loss and Activation Functions, Regularization Strategies, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory Units (LSTM), Auto Encoders;

*Reinforcement Learning:* Introduction to Reinforcement Learning, Multi-Armed Bandit Problem, Finite Markov Decision Processes, Dynamic Programming, Eligibility Traces, Policy Gradient Methods, Deep-Q Learning; *Applications and Case Studies:*

R. Shrivastava

J. S. Chahal

S. K. Singh

S. K. Singh

S. K. Singh

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**Texts / References:**

1. J. Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis, Cambridge University Press, 2004.
2. D. Koller and N. Friedman, Probabilistic Graphical Models – Principles and Techniques, MIT Press, 2009.
3. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2017
4. R. Sutton, *Reinforcement Learning – An Introduction*, MIT Press, 1998

**PHD101 Systems Design for Industrial Automation**

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<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Contents**

Introduction: Embedded Systems, Applications in Industrial Automation, Networked Systems Design.  
 System Modelling: System Specification, Hardware/Software: Partitioning Problem, Cost Estimation, Co-Design, System Specification and Modelling.  
 RTOS: Task Scheduling, Handling of Interrupts and Timing Analysis.  
 End Effectors: Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Two Fingered and Three Fingered Grippers, Internal Grippers and External Grippers.  
 Basics Of Automation: Co-Ordinate Systems, Work Envelope, Pitch, Yaw, Roll, Joint Notations, Forward Kinematics, Inverse Kinematics of Manipulators Controller for Two, Three Degrees of Freedom.  
 Sensors: Sensors for Motion, Vision, Sonar, Joint Movement Etc. Commonly Used in Industrial Automation.  
 Drives Controller: Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drive, DC Servo Motors, AC Servo Motors, Stepper Motor, Controller Design, I/O Interfacing With Different Drives and Sensors Using Advanced Microcontrollers, Optimization and Implementation Techniques Using Suitable Embedded Controllers and FPGA.

**Text/References:**

1. Massimo Banzi and Michael Shiloh Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make), Maker Media, Inc; 4 Edition, 2017
2. Bijoy K. Ghosh, T. J. Tarn and Ning Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press (28 June 2011)
3. K.S. Fu, C. S. George Lee and Ralph Gonzalez., Robotics Control, Sensing, Vision and Intelligence, McGraw, 1987.
4. Nicholas Odrey, Mitchell Weiss, Mikell Groover, Roger Nagel, Ashish Dutta, Industrial Robotics - SIE: Technology - Programming and Applications MacGraw Hill, 2017

**Decision: Noted & Approved.**

**Agenda  
Item:  
21.04**

**Seeking Approval of Holiday list for 2020.**

The holiday list for the year 2020 as per Central Government notification are placed below.

**HOLIDAY LIST FOR 2020**

S/No.	Occasion / Festival	Month & date	Day
1	Makar Sankranti	15 <sup>th</sup> January	Wednesday
2	Republic Day	26 <sup>th</sup> January	Sunday
3	Nyokum	26 <sup>th</sup> February	Wednesday

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4	Holi	10 <sup>th</sup> March	Tuesday
5	Mahavir Jayanti	6 <sup>th</sup> April	Monday
6	Good Friday	10 <sup>th</sup> April	Friday
7	Vaisakhi / Bohag Bihu	14 <sup>th</sup> April	Tuesday
8	Buddha Purnima	7 <sup>th</sup> May	Thursday
9	Eid-ul-Fitar	25 <sup>th</sup> May	Monday
10	Eid-ul-Zuha (Bakr Id)	1 <sup>st</sup> August	Saturday
11	Independence Day	15 <sup>th</sup> August	Saturday
12	Muharram	30 <sup>th</sup> August	Sunday
13	Mahatma Gandhi Jayanthi	2 <sup>nd</sup> October	Friday
14	Maha Ashtami (Durga Puja)	23 <sup>rd</sup> October	Friday
15	Dussehra	25 <sup>th</sup> October	Sunday
16	Diwali (Deepavali)	14 <sup>th</sup> November	Saturday
17	Eid-e-Milad (Prophet Mohammad's Birthday)	30 <sup>th</sup> October	Friday
18	Guru Nanak's Birthday	30 <sup>th</sup> November	Monday
19	Christmas day	25 <sup>th</sup> December	Friday

**Note: Director's Discretion: Any Two days**

**Decision: Noted & Approved.**

**Agenda Item: 21.05** Reporting of Ph. D. Open house viva-voce examinations.

Total of 6 (Six) Ph.D. scholars have defended their Ph.D. thesis the details are given in ANNEXURE 21.05

S/n	Name of Scholar	Department	Defended on	Remarks
1	SANJIB KALITA	ECE	23.08.19	Already approved in 20 <sup>th</sup> Senate
2	SANDIP KUMAR MANDAL	ME	27.09.19	
3	DEBORAJ MUCHAHARY	ECE	28.09.19	
4	BHOLANATH DOLAI	BAS (Chem.)	01.11.19	
5	SAIKAT GHOSH	BAS (Chem.)	01.11.19	
6	INDRAJIT KUMAR	M&H	24.10.19	

**Decision: Approved and recommended.**

**Agenda Item: 21.06** Issues of 6th Convocation to be held on 14th December, 2019

The proposed date of 6<sup>th</sup> Convocation at NIT - Arunachal Pradesh is 14<sup>th</sup> December, 2019. In this regard, proposal was sent to invite Shri. Kiren Rijiju Hon'ble Minister of State (Independent Charge) for Youth & Affairs & Sports and Minister of State for Minority Affairs,, Govt. of India, as a Chief Guest for the occasion.

**Decision: Approved.**

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**Agenda****Item:**  
**21.07****Reporting of Degree awardees to the B. Tech, M. Tech, MS, Online MBA & Ph. D students in the 6th Convocation**

A total of 223 students (B. Tech: 150, M. Tech: 50, MS: 11, Online MBA: 3, M.Phil:3 PhD: 6) will be awarded degree in the 6<sup>th</sup> Convocation of NIT Arunachal Pradesh. The detailed student's lists are given below:

Lists of B. Tech degree awardees:

**Department of Biotechnology (BT)**

Sl.	Name	Roll No.	Registration No.
1	ARBIN NATH	BT/15/01	0000000576/A/2015
2	SURAJ SINGH	BT/15/02	0000000577/A/2015
3	KIDAR ETE	BT/15/03	0000000578/A/2015
4	GUMIN DOYOM	BT/15/04	0000000579/A/2015
5	KUSUM KUMARI	BT/15/06	0000000580/A/2015
6	TAMO KARI	BT/15/07	0000000581/A/2015
7	TAGE LALYANG	BT/15/08	0000000582/A/2015
8	SHUBHRA KUMARI	BT/15/09	0000000583/A/2015
9	NARMI TABING	BT/15/10	0000000584/A/2015
10	DEBAJYOTI GHOSH	BT/15/11	0000000585/A/2015
11	SMRITI SINHA	BT/15/12	0000000586/A/2015
12	ASWANI KUMAR SHARMA	BT/15/13	0000000587/A/2015
13	PRASANTA PEGU	BT/15/15	0000000589/A/2015
14	MD. ANWAR ALAM	BT/15/16	0000000590/A/2015
15	AARAB GATES	BT/15/17	0000000591/A/2015
16	PRASHANT KUMAR	BT/15/19	0000000593/A/2015
17	RAMSHANKAR KUMAR	BT/15/20	0000000594/A/2015
18	GOVIND KUMAR	BT/15/21	0000000595/A/2015
19	SHAILESH KUMAR	BT/15/22	0000000596/A/2015
20	DURGANAND RAM	BT/15/23	0000000597/A/2015

**Department of Civil Engineering (CE)**

Sl.	Name	Roll No.	Registration No.
1	ROTOM SANGMA	CE/15/02	0000000530/A/2015
2	MIDING LIBANG	CE/15/04	0000000532/A/2015
3	MIDO GAMNOH	CE/15/05	0000000533/A/2015
4	TINKU CHOUDHURY	CE/15/06	0000000534/A/2015
5	LIMI KAMKI	CE/15/07	0000000535/A/2015
6	HAGE SUNYA	CE/15/08	0000000536/A/2015
7	KHYODA MAMU	CE/15/09	0000000537/A/2015
8	ARUN BISWAS	CE/15/10	0000000538/A/2015
9	SUDHANSHU KUMAR	CE/15/12	0000000539/A/2015
10	PANKAJ KUMAR	CE/15/13	0000000540/A/2015
11	NAGA RIGAM	CE/15/14	0000000541/A/2015
12	ABHAY KUMAR YADAV	CE/15/15	0000000542/A/2015
13	PRABINA KUMAR SAHU	CE/15/17	0000000543/A/2015
14	GANESH MALLAH	CE/15/18	0000000544/A/2015

*Prashant**Prashant**Prashant**Prashant*



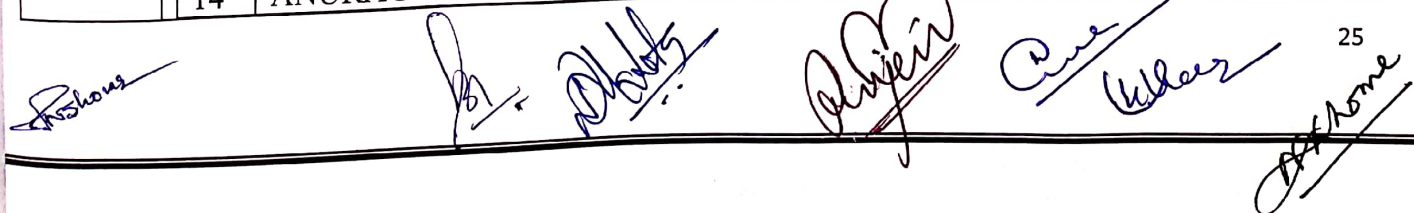
15	DEEPAK MISHRA	CE/15/19	0000000545/A/2015
16	LAKSHYA YADAV	CE/15/23	0000000575/A/2015
17	KHUSHAL GUNAWAT	CE/15/24	0000000547/A/2015
18	ANKUR SHARMA	CE/15/25	0000000548/A/2015
19	KUMAR SHANTANU	CE/15/26	0000000549/A/2015
20	VIBHUTI KUMAR	CE/15/27	0000000550/A/2015
21	ANIL CHOUDHARY	CE/15/28	0000000551/A/2015
22	ANIL KUMAR	CE/15/29	0000000552/A/2015

**Department of Chemical Engineering (CHE)**

Sl.	Name	Roll No.	Registration No.
1	ARPIT DUBEY	CHE/15/01	0000000553/A/2015
2	ASHISH TIWARI	CHE/15/02	0000000554/A/2015
3	VISHAK NAIR	CHE/15/03	0000000555/A/2015
4	PARIMAL MANDAL	CHE/15/04	0000000556/A/2015
5	ASHISH NANDI	CHE/15/05	0000000557/A/2015
6	AVINASH DUBEY	CHE/15/07	0000000559/A/2015
7	KUMAR ABHISHEK PRATAP	CHE/15/09	0000000560/A/2015
8	PRITAM PEGU	CHE/15/12	0000000561/A/2015
9	AYUSHI MISHRA	CHE/15/13	0000000562/A/2015
10	K S DEEPAK	CHE/15/14	0000000563/A/2015
11	RITU SHARMA	CHE/15/19	0000000565/A/2015
12	ZEMWA JANGNO	CHE/15/20	0000000566/A/2015
13	PRITI KUMARI	CHE/15/21	0000000567/A/2015
14	NIKHIL UTSAV	CHE/15/22	0000000568/A/2015
15	PRIYA RANI	CHE/15/23	0000000569/A/2015
16	MD SHAIK ALI	CHE/15/24	0000000570/A/2015
17	SANKALP SINHA	CHE/15/25	0000000571/A/2015
18	ROHITASH MEENA	CHE/15/29	0000000574/A/2015

**Department of Computer Science and Engineering (CSE)**

Sl.	Name	Roll No.	Registration No.
1	SHIVAM KR. SINGH	CSE/15/01	0000000453/A/2015
2	INDERJEET AGARWAL	CSE/15/04	0000000454/A/2015
3	KAUSHIK DUTTA	CSE/15/06	0000000456/A/2015
4	AMIT DAS	CSE/15/08	0000000457/A/2015
5	SUBHAYU MUKHERJEE	CSE/15/09	0000000458/A/2015
6	CHIRAG SHUKLA	CSE/15/10	0000000459/A/2015
7	TRIDIP PHUKAN	CSE/15/11	0000000460/A/2015
8	CHANDRA MOCHAHARY	CSE/15/13	0000000461/A/2015
9	SUMIT KUMAR PANDIT	CSE/15/14	0000000462/A/2015
10	SIDDHARTH GOSWAMI	CSE/15/15	0000000463/A/2015
11	KUMOD KUMAR YADAV	CSE/15/16	0000000464/A/2015
12	MITHILESH KUMAR RAM	CSE/15/17	0000000465/A/2015
13	VIDYA GUPTA	CSE/15/18	0000000466/A/2015
14	ANURAG CHATURVEDI	CSE/15/19	0000000467/A/2015





15	AMIT KUMAR MEENA	CSE/15/20	0000000468/A/2015
16	AMRIT RAJ	CSE/15/21	0000000469/A/2015
17	DURGESH KUMAR	CSE/15/22	0000000470/A/2015
18	ALIGE SANDEEP KUMAR	CSE/15/23	0000000471/A/2015
19	ARVEET SINGH	CSE/15/24	0000000472/A/2015
20	SAMARTHA KAR	CSE/15/25	0000000473/A/2015
21	ASHISH MANDAL	CSE/15/26	0000000474/A/2015
22	APURVA MISHRA	CSE/15/27	0000000475/A/2015
23	MINK SHREE DUTTA	CSE/15/28	0000000606/A/2015

**Department of Electronics and Communication Engineering (ECE)**

Sl.	Name	Roll No.	Registration No.
1	ANKITA AGARWAL	ECE/15/02	0000000479/A/2015
2	BEROLINA MARY NONGDHAR	ECE/15/04	0000000501/A/2015
3	BHUPENDRA KUMAR	ECE/15/05	0000000490/A/2015
4	GAUTAM KUMAR	ECE/15/06	0000000497/A/2015
5	JAISE P THOMAS	ECE/15/07	0000000480/A/2015
6	JUNAID MOHAMMAD KHAN	ECE/15/08	0000000481/A/2015
7	KORUKONDA MEHER VIHARI	ECE/15/10	0000000482/A/2015
8	LIKHA TADH	ECE/15/11	0000000502/A/2015
9	MAINAK CHANDRA	ECE/15/12	0000000483/A/2015
10	MANOJ SINGH	ECE/15/13	0000000491/A/2015
11	NIDHI PRIYA SINGH	ECE/15/14	0000000484/A/2015
12	NIVESH KUMAR MISHRA	ECE/15/15	0000000485/A/2015
13	RAKESH KUMAR MAHATO	ECE/15/16	0000000492/A/2015
14	ROSHAN KUMAR	ECE/15/18	0000000493/A/2015
15	TSANG LEDA	ECE/15/19	0000000503/A/2015
16	VAKADA SHIVAJI	ECE/15/20	0000000494/A/2015
17	Y. GREESHMA REDDY	ECE/15/21	0000000486/A/2015
18	J SANTHOSH KUMAR	ECE/15/23	0000000499/A/2015
19	AMIT KUMAR CHOUDHARI	ECE/15/24	0000000500/A/2015
20	SANDEEP KUMAR YADAV	ECE/15/25	0000000476/A/2015
21	ASHISH KUMAR SAHU	ECE/15/26	0000000477/A/2015
22	GAURAV KUMAR	ECE/15/28	0000000504/A/2015
23	SHIVAM KUMAR RAI	ECE/15/30	0000000488/A/2015

**Department of Electrical Engineering (EE)**

Sl.	Name	Roll No.	Registration No.
1	SHRIHARI MANI TRIPATHI	EE/15/03	0000000600/A/2015
2	DIPENDRA KUMAR MEENA	EE/15/04	0000000601/A/2015
3	NITISH KUMAR	EE/15/05	0000000602/A/2015
4	ARIF REZA KHAN	EE/15/06	0000000603/A/2015
5	CHANDAN ROY	EE/15/07	0000000604/A/2015
6	YARRAMILLI N S A ANAND	EE/15/08	0000000622/A/2015
7	GANDEPALLI SAI TEJA	EE/15/09	0000000605/A/2015
8	ROUNAK AGRAWAL	EE/15/11	0000000607/A/2015
9	BRIJESH KUMAR PATEL	EE/15/13	0000000609/A/2015
10	THUTAN TENZIN	EE/15/14	0000000610/A/2015

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*Sh. D. D. D.*

*One*

*Ullker*

*Wshome*



11	JAI DEV SINGH	EE/15/15	0000000611/A/2015
12	PRINCE TIWARI	EE/15/16	0000000612/A/2015
13	SWAPNIL SEN	EE/15/17	0000000613/A/2015
14	DAKLI DABI	EE/15/18	0000000614/A/2015
15	AMAN KUMAR	EE/15/20	0000000616/A/2015
16	SAURAV KUMAR	EE/15/21	0000000617/A/2015
17	RAVISHEK KUMAR SINGH	EE/15/22	0000000618/A/2015
18	ANSHUMAN SINGH	EE/15/23	0000000619/A/2015
19	KAVITA KUMARI	EE/15/24	0000000620/A/2015
20	VAIBHAV KUMAR MANGAL	EE/15/25	0000000621/A/2015

**Department of Mechanical Engineering (ME)**

Sl.	Name	Roll No.	Registration No.
1	CHOW KHUNSENG	ME/15/01	0000000505/A/2015
2	TAKUP SAMNAM	ME/15/03	0000000506/A/2015
3	KAMAL KISHORE RAI	ME/15/04	0000000507/A/2015
4	RAKESH KR CHOUDHARY	ME/15/07	0000000508/A/2015
5	HRISHIKESH PURI	ME/15/08	0000000509/A/2015
6	TAKU MIBANG	ME/15/09	0000000510/A/2015
7	BHASKAR GOGOI	ME/15/12	0000000511/A/2015
8	KISHAN KUMAR RAJAK	ME/15/13	0000000512/A/2015
9	RISHEESH MISHRA	ME/15/14	0000000513/A/2015
10	ARUN KUMAR VERMA	ME/15/15	0000000514/A/2015
11	ANSHUMANYADAV	ME/15/16	0000000515/A/2015
12	ADITYA KUMAR	ME/15/17	0000000516/A/2015
13	RANJANYADAV	ME/15/18	0000000517/A/2015
14	DEBAPRIYA NATH	ME/15/19	0000000518/A/2015
15	ABHIJIT DAS	ME/15/20	0000000519/A/2015
16	DEEPAK KUMAR MANDAL	ME/15/21	0000000520/A/2015
17	AMIT KUMAR	ME/15/22	0000000521/A/2015
18	TARIQ MOHI-UD-DIN	ME/15/23	0000000522/A/2015
19	MD. WAQUAR ZAIDEE	ME/15/24	0000000523/A/2015
20	PASUPULETI MONISH	ME/15/25	0000000524/A/2015
21	SONU KUMAR	ME/15/26	0000000525/A/2015
22	SURAJ KUMAR PASWAN	ME/15/27	0000000526/A/2015
23	MUNNA RAM	ME/15/28	0000000527/A/2015
24	DURGA PRASAD YADAV	ME/15/29	0000000528/A/2015

Lists of M. Tech degree awardees:

**Department of Management and Humanities**  
**M. Tech in Appropriate Technology and Entrepreneurship**

Sl.N	Name	Roll No.	Registration
1	MOHAMMAD KAREEM	ATE/17/01	00218/C/2017

*Prashant*

*Prashant*

*Prashant*

*Prashant*

*Prashant*

2	ADITYA AJAY DUBEY	ATE/17/02	00214/C/2017
3	RAVI KUMAR SINGH	ATE/17/03	00220/C/2017
4	AFAQUE SIDDIQUI	ATE/17/04	00215/C/2017
5	BISWADEEP SEN	ATE/17/05	00216/C/2017
6	PRATIT DAS	ATE/17/06	00219/C/2017
7	GIRI SHANKAR NATH	ATE/17/07	00217/C/2017

**Department of Computer Science and Engineering**

**M.Tech. in Computer Science and Engineering**

SL	Name	Roll No.	Registration
1	NEHA JOSHI	MTCS/17/01	00255/C/2017
2	KSHITIJ MISHRA	MTCS/17/02	00253/C/2017
3	ASHISH SINGH	MTCS/17/03	00250/C/2017
4	LILAPATI WAIKHOM	MTCS/17/04	00254/C/2017
5	DEBAYAN	MTCS/17/05	00251/C/2017
6	PRAGYA SINHA	MTCS/17/06	00256/C/2017
7	YESHWANT SINGH	MTCS/17/07	00257/C/2017
8	GULAB SAH	MTCS/17/08	00252/C/2017

**Department of Electronics and Computer Engineering**

**M.Tech. in VLSI & Embedded System**

Sl. No.	Name	Roll No.	Registration
1	RAKESH KUMAR	VLSI/17/01	00232/C/2017
2	VIKASH CHANDRA MISHRA	VLSI/17/02	00234/C/2017
3	RAJARSHI MAITY	VLSI/17/04	00231/C/2017
4	SHALU SAINI	VLSI/17/05	00233/C/2017
5	MANJIMA DE SARKAR	VLSI/17/06	00230/C/2017
6	ATRAYEE DUTTA	VLSI/17/08	00228/C/2017
7	ALOK KUMAR SINGH	VLSI/17/09	00226/C/2017

**Department of Mechanical Engineering**

**M.Tech. in Mechanical System Design & Innovation Technology**

SL	Name	Roll No.	Registration
1	SAUMYA AGRAWAL	MSDIT/17/02	00247/C/2017
2	DHIRAJ KUMAR	MSDIT/17/03	00242/C/2017
3	SAURABH KAFALTIYA	MSDIT/17/04	00248/C/2017
4	PALAPARTHI NAGENDRA KUMAR	MSDIT/17/05	00246/C/2017
5	ASHISH KUMAR SINGH	MSDIT/17/06	00239/C/2017
6	BAHARUL ISLAM	MSDIT/17/07	00241/C/2017
7	SHRAVAN KUMAR YADAV	MSDIT/17/08	00265/C/2017
8	ARNAB DEB	MSDIT/17/09	00238/C/2017
9	GYATI SHAH	MSDIT/17/10	00243/C/2017
10	AMRITA SHARMA	MSDIT/17/11	00237/C/2017
11	AMIT MALAKAR	MSDIT/17/12	00236/C/2017
12	VIPLAV SINGH RAWAT	MSDIT/17/13	00249/C/2017
13	TAMO TAKUNG	MSDIT/17/15	00266/C/2017
14	ASHUTOSH SINGH	MSDIT/17/17	00240/C/2017
15	SANJIB KALITA	MSDIT/17/18	00264/C/2017
16	PRONAMIKA BORTHAKUR	MSDIT/17/19	00263/C/2017



17	BEENAM BENGIA	MSDIT/17/20	00261/C/2017
18	SURAJ TOPPO	MSDIT/16/13	00190/C/2016

**Department of Electrical Engineering**  
**M.Tech. in Renewable Energy and Energy Management**

SL	Name	Roll No.	Registration
1	PARWEZ ALAM	REEM/17/01	00223/C/2017
2	PRANITA BAISHYA	REEM/17/02	00224/C/2017
3	NGANGA GUMSAR SORUM	REEM/17/03	00222/C/2017
4	SHYAMAL KUMAR DE	REEM/17/04	00225/C/2017
5	MRIGANKA BORAH	REEM/17/05	00221/C/2017
6	PALLAVI KUMARI	REEM/17/06	00267/C/2017
7	RANJEET RAJ	REEM/16/15	00208/C/2016
8	ROSHAN KUMAR SHUKLA	REEM/16/17	00211/C/2016

**Department of Computer Science and Engineering**  
**M.Tech. in Mobile Communication Computing**

SL	Name	Roll No.	Registration
1	HEMANGA JYOTI SARMA	MCC/17/02	00259/C/2017
2	AISHWARYA SINGH GAUTAM	MCC/17/03	00258/C/2017

Lists of MS degree awardees

**Department of Basic & Applied Science**  
**MS in Mathematical Physics**

Sl.	Name	Roll No.	Registration
1	VIKRANT KUMAR VERMA	MP/17/01	00039/E/2017
2	JADAV SURBHIBEN	MP/17/02	00032/E/2017
3	KUKKADAPU KUMAR AKHIL	MP/17/03	00033/E/2017
4	NILANJAN NANDI	MP/17/04	00035/E/2017
5	AJIT KUMAR DASH	MP/17/05	00030/E/2017
6	DIGVIJAY SINGH TOMAR	MP/17/06	00031/E/2017
7	SHALOM FRANDEV	MP/17/07	00037/E/2017
8	TARAK RIMI	MP/17/08	00038/E/2017
9	NADA RIMA	MP/17/09	00034/E/2017
10	SAGAR BHATTARAI	MP/17/10	00036/E/2017
11	SUSMITA SUDHAKAR GAVALI	MP/16/03	00020/E/2016

Lists of Online MBA degree awardees:

Sl.	Name	Roll No	Registration No.
1	GOLLO JANAM	OLMBA/15/05	00003/D/OLMBA/2015
2	AMRITA DEB JANA	OLMBA/16/01	00004/D/OLMBA/2016

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3	TELI YANI	OLMBA/16/02	00005/D/OLMBA/2016
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Lists of M. Phil. degree awardees:

Sl.	Name	Roll No	Registration No.
1	BIPLAB KUMAR DEY	OLMPHIL/16/01	00001/F/OLMPHIL/2016
2	PRADIP KUMAR GUPTA	OLMPHIL/16/04	00002/F/OLMPHIL/2016
3	RAJANISH PANDEY	OLMPHIL/16/05	00003/F/OLMPHIL/2016

Lists of Ph. D degree awardees:

Sl.	Name	Roll No	Registration No.
1	SANJIB KALITA	Ph.D.(ECE)/2016/04	00026/B/ECE/2015
2	SANDIP KUMAR MANDAL	Ph.D/15/ME/01	00029/B/ME/2015
3	DEBORAJ MUCHAHARY	Ph.D(ECE)/2016/02	00022/B/2016
4	BHOLANATH DOLAI	Ph.D(CHEM)/2015/0	00033/B/2015
5	SAIKAT GHOSH	Ph.D(CHEM)/2016/0	00032/B/2016
6	INDRAJIT KUMAR	Ph.D/M&H/2015/01	00017/B/HU/2015

**Decision: Noted and Approved.**

**Agenda  
Item:  
21.08**

**Reporting of the Gold Medal winners:**

15 students will be awarded for Gold Medals in different categories, accordingly committee was formed and students are selected as under:

**A. Institute Gold Medal:** Institute Gold Medals, one for each of the disciplines under Bachelor of Technology (B. Tech), Master of Technology (M. Tech) and Master of Science (MS) programs of the institute will be awarded each year to the student who rank first, obtaining the highest CGPA among all graduating students in his/her discipline in that year.

**1. Institute Gold Medal**

Sl. No.	Department	Name of the Student	CGPA
<b>B. TECH.</b>			
1.	Biotechnology (BT)	GOVIND KR. GULASHAN	8.59
2.	Civil Engineering(CE)	ANKUR SHARMA	9.08
3*	Chemical Engineering(CHE)	ASHISH TIWARI	8.89
4.	Computer Science & Engineering(CSE)	AMIT DAS	8.55
5.	Electronic & Communication Engineering(ECE)	ASHISH KUMAR SAHU	8.31

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6.	Electrical Engineering(EE)	THUTAN TENZIN	8.88
7.	Mechanical Engineering(ME)	CHOW KHUNSENG MANCHEYKHUN	9.06
<b>M. TECH / MS</b>			
8.	Mathematical Physics (MP)	AJIT KUMAR DASH	9.39
9.	Renewable Energy & Energy Management(REEM)	MRIGANKA BORAH	9.19
10.	Appropriate Technology and Entrepreneurship ( ATE)	AFAQUE SIDDIQUI	8.85
11.	M. Tech in Computer Science & Engineering(MTCS)	KSHITIJ MISHRA	9.01
12.	Mobile Communication Computing(MCC)	AISHWARYA SINGH GAUTAM	8.12
13.	Mechanical System Design and Innovation Technology (MSDIT)	DHIRAJ KUMAR	9.31

\* Mr. Shaif Ali (CHE/15/24) has highest overall CGPA but he had failed in one subject in 5<sup>th</sup> semester, therefore 2<sup>nd</sup> highest Mr. Ashish Tiwari has been chosen. And no students of VLSI course are eligible for above Gold Medals.

**B. Chairman's Gold Medal:** The Chairman's Gold Medal will be awarded each year to that student who stands first securing the highest CGPA among all the students of the batch receiving the Bachelor of Technology (B. Tech) and Master of Technology (M. Tech) in that batch.

Sl. No.	Course	Name of the Student	CGPA
1.	Civil Engineering	ANKUR SHARMA	9.08
2.	Mathematical Physics	AJIT KUMAR DASH	9.39

**Decision: Noted and Approved.**

**Agenda Item: 21.09** Seeking approval for M.Tech. and M.S ordinances

According to 20th Senate, the modification of M.Tech & MS ordinances has been done and the same is placed for approval.

*Ashish*

*[Signature]*

*[Signature]*

*[Signature]*

*[Signature]*

*[Signature]*

**Decision: Noted and Approved.**

**Agenda Item: 21.10 Seeking approval for full time institute fellowship Ph.D. for Jan-June 2020 session**

Since only 11 (Eleven) full time (institute fellowship) Ph.D. scholars are admitted since its establishment 2010, hence and keeping in view of present faculty strength total of 35 full time Ph.D. scholars are proposed for session Jan-June 2020:

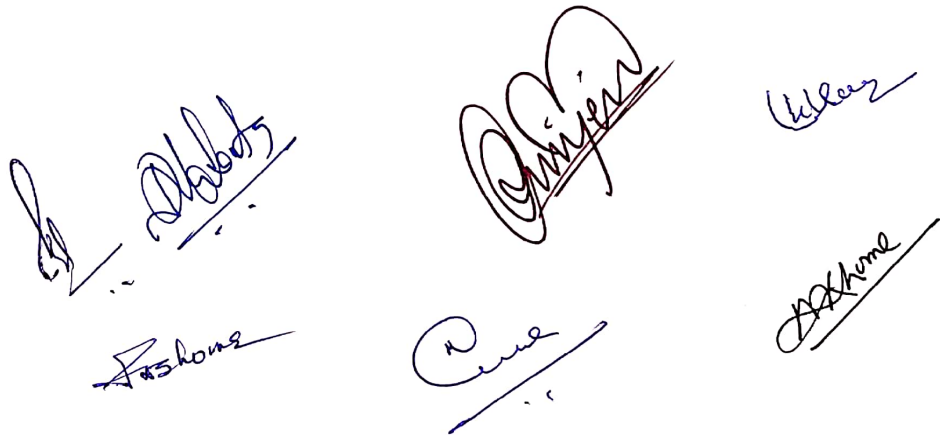
The rough expenditure for 3 (Three) years are estimated below:

No. of scholars	Months	Honorarium	Total
35	12	31000	1,30,20,000
35	12	31000	1,30,20,000
35	12	35000	1,47,00,000
Total			<b>4,07,40,000/-</b>

**Decision: Noted and recommended.**

Meeting was ended with vote of thanks from Chairman

\*\*\*



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