

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

**NAME OF DEPARTMENT/CENTRE/SCHOOL: Electronics and Communication
Engineering**

Subject Code: IEC-03

Course Title: Artificial Intelligence Techniques

L-T-P: 3-1-0

Credits: 4

Subject Area: IEC

Course Outlines:

Introduction to Artificial Intelligence; Search; Knowledge, Reasoning and Planning; Uncertainty Theory and Learning; Computational Learning Theory; Artificial Neural Network; Introduction to Deep Learning; Applications of AI.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Electronics and Communication Engineering

Subject Code: IEC-04

Course Title: Industrial and Medical Applications of RF Energy

L-T-P: 3-1-0

Credits: 4

Subject Area: IEC

Course Outlines:

Electromagnetic spectrum and ISM bands, Concept of impedance matching, Electromagnetic resonators, Klystrons and Magnetrons, RF heating and its applications, Multimode oven, Applications in leather and textile industries, Applications in food industries, Biological and medical applications, Thermal interaction with living organisms, RF exposure and emission standards, Safety precautions.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE/SCHOOL: Electronics and Communication Engineering

Subject Code: IEC-05

Course Title: Semiconductor Devices and VLSI

L-T-P: 3-1-0

Credits: 4

Subject Area: IEC

Course Outlines:

Semiconductor fundamentals, band-diagrams, electrostatics, drift and diffusion transport
Semiconductor devices, diodes, capacitors and transistors, operation regimes, terminal characteristics of interest, figures of merit, scaling and state-of-the-art, small signal model of transistors, analysis of amplifier circuits, high-frequency model of transistors, frequency domain representation of amplifier properties, determining the location of poles and zeroes, Miller's theorem, Static CMOS logic, Inverter, static and dynamic characteristic, ratioed logic, Dynamic logic, pass-transistor logic, Hardware description language, FPGA Architecture, configurable logic blocks (CLBs) overview, Look-Up Tables (LUTs), and Flip-Flops (FFs) in Hardware, Look ahead Carry Chain Architecture.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Centre for Photonics and Quantum Communication Technology

1. **Subject Code:** IPQ-301 **Course Title:** A Primer in Quantum Technology
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To familiarize students with the foundations of quantum technology and its cutting-edge applications.

10. Details of the Course

S.No.	Particulars	Contact Hours
1.	Foundations of Quantum Technology: Wave-particle Duality and Schrödinger Equation, one-dimensional potential well, operators and measurements, time evolution of quantum States, quantum coherence, qubits, Bloch sphere, quantum entanglement, quantum tunnelling.	10
2.	Light-atom Interactions: Light-atom interaction, transition probabilities, Rabi frequency, single photon sources and detectors.	6
3.	Quantum Computing: Quantum gates, quantum circuits, Bell states, Bell inequalities, requirements for loophole-free Bell tests, fidelity, reduction techniques, quantum algorithms, physical realization of quantum computing.	11
4.	Quantum Networks and Secure Communications: Building blocks of quantum networks, Quantum memory/repeaters photon polarization and its applications in quantum networks, quantum key distribution (QKD), no-cloning theorem, cryptography, BB84 protocol.	11
5.	Quantum Sensing: Introduction to Sensors, concept of quantum sensors, Performance parameters: classical vs. quantum sensors, Quantum plasmonic sensors.	4
Total		42

11. Suggested Books:

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	R. Eisberg and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles," Wiley	2006
2.	M. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press	2010
3.	Rodney van Meter, "Quantum Networking," Wiley	2014
4.	Ramona Wolf, "Quantum Key Distribution: An Introduction with Exercises," Springer	2021

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF THE DEPARTMENT: **EARTH SCIENCES**

1. Subject Code: **IES-301** Course Title: **FRACTALS AND APPLICATIONS**

2. Contact Hours : **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs): **Theory** 2 **Practical** 0

4. Relative Weightage: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits : 3 6. Semester: **Both** 7. Subject Area: **BGSEC**

8. Pre-requisite: Nil

9. Objective: To introduce the concepts of fractal geometry and its applications.

10. Details of Course:

S. No	Contents	Contact Hours
1.	Mathematical background, self similarity, Sierpinski triangles, Koch curves, cantor sets	4
2.	Box-counting dimensions, Kolmogrov capacity, 1D and 2-D box counting	3
3.	Hausdorff measures and dimension, deterministic and random fractals, natural fractals, iterated function systems, stochastic dynamical systems, compression of images	7
4.	Dynamical systems, interval self-mappings, complex iteration, perturbation theory, geometrical theory, small divisors, deterministic chaos to deterministic division	7
5.	Applications in fragmentation, tectonics, geomorphology, seismology	4
6.	Applications in other fields, image compression, finance, soil mechanics	5
Total		30

11. Suggested Books:

S. No	Name of Authors/ Books/ Publishers	Year of Publication Reprint
1.	Schroeder, Manfred, "Fractals, Chaos, Power laws: Minutes from an infinite paradise", Dover	2009
2.	Ott, Edward, "Chaos in dynamical systems", Cambridge Univ. Press, 2 nd ed.	2005
3.	Falconer, Kenneth, "Fractal Geometry: Mathematical foundations and application", Wiley Pub.	2003
4.	Sprott, Julien Clinton, "Chaos and Time Series Analysis", Oxford Univ. Press	2003
5.	Turcotte, Donald.E., "Fractals and Chaos in Geology and Geophysics", Cambridge Univ Press	1997
6.	Peitgen, Heinz-Otto, Jurgens, Hartmut, Saupe, Dietmar, Maletsky, Evan M., Perciante, Terry & Yunker, Lee E, "Fractals for the classroom", Springer Verlag	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Earth Sciences

1. **Subject Code:** IES-06 **Course Title:** Carbon Sequestration
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Autumn **7. Subject Area:** OEC
8. **Pre-requisite:** Basic understanding of the Earth system science
9. **Objective:** To impart understanding of carbon capture and storage processes.

10. Details of the Course

S. No.	Contents	Contact Hours
1.	Climate drivers: Statue of climate change, regional and global climate change, factors governing global climate, natural and human- caused climate drivers, feedback mechanisms, radiative forcing, greenhouse effect, global warming, various greenhouse gases sources and their relative contribution in global warming.	5
2.	Carbon history: Carbon cycle, global carbon budget, calculating carbon budget in terms of equivalent atmospheric CO ₂ , history of atmospheric CO ₂ through geological time, methods to monitor atmospheric CO ₂ , proxy for past CO ₂ reconstruction, ice-core and marine sedimentary records.	4
3.	Carbon source and sink: Global carbon flux, sources and sinks of atmospheric carbon, natural CO ₂ source, biological pump, oceanic, terrestrial, forest, permafrost, wetlands and soil carbon sink, terrestrial silicate weathering, CO ₂ fertilization, Carbon sequestration.	4
4.	Carbon storage and monitoring: Geological storage, rocks for CO ₂ storage, storage in reservoirs, seals, traps, aquifers and depleted oil fields, CO ₂ storage during enhanced oil recovery, saline aquifer, deep unmineable coal beds, deep sea basalt, trapping mechanisms, geomechanical properties of CO ₂ geological storage, physical processes during CO ₂ storage, leakage and monitoring, measurement and verification techniques during CO ₂ storage, risks and challenges in CO ₂ storage, possible hazards associated with carbon sequestration, economic considerations.	6
5.	Carbon removal: Ocean fertilization (FLOHAFEX Experiment), enhanced terrestrial weathering, ocean alkalinity enhancement, pros and cons of foresting deserts, limitations for planting trees, Carbon neutrality, existing and future technologies for removing Carbon directly from the atmosphere, Carbon dioxide scrubber, Carbon dioxide air capture, clean coal, amine gas treating, membrane gas separation, and metal-organic framework, radiative forcing geoengineering technologies, negative emissions technologies.	6

6.	Climate change policies: Strategies for mitigation of climate change, global climate action, IPCC assessment reports and mitigation policies for climate change, Paris climate agreement 2017, Kyoto protocol, Carbon capture and sequestration potential in India.	3
Total		28

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/Reprint
1.	Langmuir, C. H. and Broecker, W. S., "How to Build a Habitable Planet: The Story of Earth from the Big Bang to Humankind". Princeton University Press	2012
2.	McPherson, B., J. and Sundquist, E. T., "Carbon Sequestration and Its Role in the Global Carbon Cycle" AGU Publications	2013
3.	Morgado, C.R.V. and Esteves, V., "CO2 Sequestration and Valorization." Intechopen publications.	2014
4.	Vishal, V. and Singh, T.N., "Geologic Carbon Sequestration: Understanding Reservoir Behavior." Springer	2016
5.	IPCC Assessment Report	2019

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **IHS-308** Course Title: **Gender and Culture Studies**
 2. Contact Hours: **L: 2 T: 1 P: 0**
 3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**
 4. Relative Weight: **CWS: 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**
 5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**
 8. Pre-requisite: **Nil**
 9. Objective: To enhance students' understanding of gender and culture and to broaden their perception of these categories in an international context.
 10. Details of Course:

Sl. No.	Contents	Contract Hours
1	Introduction: Development of Gender Theories, Correlation between Gender and Culture Theories, History and Concept of Feminism, Understanding Post-modernism and its Intersection with Feminist Theories, Fracturing Binarisms. Discussion of relevant texts.	6
2	Theories of the Construction of Gender: Materialist and Discursive Theories, Gender and Language. Discussion of relevant texts.	4
3	Gender and Society: Gender as a Social Construct, Gender differences and inequalities, Gender and/as Caste, Class, Family, Work, Property Rights. Discussion of relevant texts.	4
4	Gendered Identities: Role of Gender in Individual Cognition of Social Roles, Production of Masculinity and Femininity, Experience vs. Institution, Understanding third Genders. Discussion of relevant texts.	6
5	Culture through Gender: Post-modernist Cultural Theories, Impact of Culture on Women's Movements. Discussion of relevant texts.	4
6	International Issues: Migration and Women, Multiculturalism, Gender and Media Representation, Gender and Science/Technology. Discussion of relevant texts.	4
Total		28


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11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Alsop R., Fitzsimous A., and Lennon K., "Theorizing Gender", Blackwell Publishers.	2002
2.	Barker C. "Cultural Studies: Theory and Practice", Sage.	2003
3.	Butler J., "Gender Trouble: Feminism and the Subversion of Identity", Routledge.	1990
4.	De Beauvoir S., "The Second Sex", Penguin Books.	1984
5.	Glover, D and Kaplan C. "Genders", (Ed.), Routledge.	2000
6.	Jackson S. and Scott S., "Gender: A Sociological reader", (ed.), Routledge.	2002
7.	Mary W., Donna G., Mary B., Hatice O., and Wayne, M., "Women, Science and Technology: A Reader in Feminist Science Studies", 2 nd Ed. , Routledge.	2009


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-316 **Course Title:** Medical Humanities
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To familiarize students with the concepts and different theories of Medical Humanities.
10. **Details of the Course**

S.No.	Contents	Contact hours
1.	Introduction: Medical Humanities as putatively Interdisciplinary discipline, Interdisciplinary aspects in Humanities	2
2.	The Ethical Aspect of Medical Humanities: Principle of Respect for Autonomy, Principle of Nonmaleficence, Principle of Beneficence, Principle of Justice, genre as social action	6
3.	Literature and Medicine: Connoisseurship of patient, Emotional existence, feminist approach, Patriarchal Approach, biomedical discourse	6
4.	Attention Disorders, Sexual Behavior, Death and Dying, The Mind and its Discontents	6
5.	(Dis)Ability and Literature, the concept of 'other', Exploring Social Issues, Functional Impairment Disability	4
6.	Narrative Medicine: How Writing Can Heal, Patient Narrative & the Real World, Narrative of Double Marginalized	4
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	The Edinburgh Companion to the Critical Medical Humanities, Whitehead A, Woods A	2016
2.	Narrative Medicine: Honoring the Stories of Illness, Charon R	2006
3.	Why Teach Literature and Medicine? Answers from Three Decades. In: New Directions in Literature and Medicine Studies, Jones AH	2017
4.	Medical Humanities: An Introduction, Cole TR, Carlin NS, Carson RA	2014
5.	Personally Speaking: Experience as Evidence in Academic Discourse, Spiegelman C	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Centre of Nanotechnology

1. **Subject Code:** INT-301 **Course Title:** Nanodevices
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To provide basic knowledge and a broad overview about various types of nanoscale devices.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Basics of nanotechnology and nanodevices: Introduction to nanoscale materials; nanoscale materials fabrication techniques – lithography, chemical vapor deposition (CVD), atomic layer deposition (ALD), molecular beam epitaxy (MBE), pulsed laser deposition (PLD), solution process, molecular self-assembly; nanomaterials based devices; advantages and challenges of nanodevices	6
2.	Nanoelectronic and nano-optoelectronic devices: Semiconducting nanomaterials and their application to nanoelectronic devices; nanoscale transistors and memory devices; nano-optoelectronic devices – photodetectors, solar cells, light emitting diodes, LASERs and their characterization techniques; molecular devices; nanodevices based on carbon nanostructures – carbon nanotubes (CNT), graphene, and carbon quantum dots	12
3.	Nanosensors and actuators: Fundamental concepts; different types of nanosensors; physical nanosensors: mechanical, thermal, optical, magnetic sensors; chemical nanosensors: gas sensors, opto-chemical, electrochemical sensors; biological nanosensors: electrochemical, CNT based, cantilever based and optical nano biosensors	12
4.	Magnetic nanodevices: Fundamentals of magnetic nanomaterials, domain, magnetic anisotropy; magnetic memory; tunnel junction; spin-valve; spintronics; magnetic nanodevices for medical and environmental applications	6
5.	Nanodevices for healthcare: Nanomedical tools; nanobots; Lab-on chip; nanosensors based smart network for healthcare	6
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/ Reprint
1.	Ramsden, J.; 'Nanotechnology: an introduction'; 2 nd Ed., Elsevier (ISBN: 9780323393140)	2016
2.	Anatoli, K., Goodnick, S., Nemanich, R.; 'Nanoscale materials and devices for electronics, photonics and solar energy'; 1 st Ed., Springer (ISBN: 978-3-319-18633-7)	2015
3.	Khanna, V. K.; 'Nanosensors: physical, chemical and biological'; 2 nd Ed., CRC press (ISBN: 9781000331271)	2021
4.	Rauta, P. R., Mohanta, Y.K., Nayak, D.; 'Nanotechnology in biology and medicine: research advances and future perspectives'; 1 st Ed., CRC press (ISBN: 9780429259333)	2019
5.	Hou, Y., Sellmyer, D. J.; 'Magnetic nanomaterials: fundamentals, synthesis and applications'; 1 st Ed., Wiley (ISBN: 978-3-527-34134-4)	2017

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
DEPARTMENT OF PHYSICS

1. Subject Code: **IPH-305** Course Title: **Quantum Computing**
2. Contact Hours: L: T: P:
3. Examination Duration (Hrs): Theory Practical
4. Relative Weightage: CWS PRS MTE ETE PRE
5. Credits:
6. Semester: Autumn Spring Both
7. Pre-requisite: PH-101 or equivalent
8. Subject Area: BGSEC
9. Objective of Course: The aim is to provide comprehensive knowledge on physics and engineering aspects of Quantum Computing.

10. Details of Course:

Sl.No.	Particulars	Contact Hours
1.	Brief history, the postulates of quantum theory, Dirac notation, Density operator and its general properties, Super-dense coding, quantum teleportation and the no-cloning theorem.	8
2.	Quantum computing: Quantum qubits, quantum logic gates, Quantum Circuits, Universal quantum gates, application of quantum computer; Deutsche's algorithm, Deutsch-Jozsa algorithm, Simon's Algorithm, Simulation of quantum system.	12
3.	Quantum Fourier Transform. Grover's algorithm, Phase estimation. Quantum Factorization. Quantum searching, Shor's algorithm, Quantum search algorithms.	12
4.	Quantum error-correction, Quantum error-correcting codes, Stabilizer codes, Fault-tolerant quantum computation, Physical Realizations of Quantum Computation.	10

11. Suggested Books:

Sl.No.	Names of Books/Authors	Year of Publication
1.	Michael A Nielsen and Isaac Chuang, Quantum computation and quantum information, Cambridge University Press.	2012
2.	Phillip Kaye, Raymond Laflamme and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press.	2007

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

NAME OF DEPARTMENT: Hydro and Renewable Energy

1. **Subject Code:** IHR-304 **Course Title:** Energy Resources, Economics and Sustainability
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 6. **Semester:** Both 7. **Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective of Course:** To provide the basic knowledge about energy systems along with economic and sustainability principles.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Overview of World energy scenario, primary energy demand and supply, fossil fuel reserves - estimates, overview of India's energy scenario and its comparison with other countries, trends in energy use patterns, energy and development linkage, formulation of energy Sankey diagrams.	5
2.	Energy chain, primary energy analysis, net energy analysis examples	4
3.	Energy economics - simple payback period, time value of money, internal rate of return, net present value, life cycle costing, levelized cost of energy.	5
4.	Project cost and benefits, economic and financial models, cost of saved energy.	5
5.	Environmental impacts of energy use - air pollution, particulates solid and water pollution, formation of pollutants, measurement and controls; sources of emissions, effect of operating and design parameters on emission	7
6.	Introduction to Life cycle assessment (LCA) and its relation with environmental decision support, LCA framework methods and standards	5
7.	LCA: mass flow, data estimation, multi functionality, Input-Output methods, impact categories, mid-point and end-point indicators, interpretation: consistency and sensitivity.	6
8.	Future energy scenarios and elements of sustainability.	5
	Total	42

11. Suggested Books:

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Energy and the Challenge of Sustainability, World energy assessment, Denim Anderson, UK, Michael Jefferson, UK, John P. Holdren, US, UNDP New York	2000
2.	Sustainable Energy - without the hot air, David JC MacKay, UIT Cambridge, England, version 3.5.2, November 03, 2008	2009
3.	Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, Mary Ann Curran, Wiley	2012
4.	Introduction to Energy Economics, Subhes C. Bhattacharyya, Springer London Dordrecht Heidelberg, New York	2011
5.	The Age of Sustainable Development, Jeffrey D. Sachs, Ki-moon Ban, Columbia University Press	2015

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: ALTERNATE HYDRO ENERGY CENTRE

1. Subject Code: IHR-302 Course Title: Renewable Energy Sources Development Technology
2. Contact Hours: L: 3 T: 0 P: 0
3. Examination Duration (Hrs.): Theory: 3 Practical: 0
4. Relative Weightage: CWS: 15 PRS: 0 MTE: 35 ETE: 50 PRE: 0
5. Credits: 3 6. Semester: Both 7. Subject Area: OEC
8. Pre-requisite: Nil
9. Objective of the Course: To provide the basic knowledge about renewable energy resources and technologies.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	Energy sources & demand in different sectors, conventional & non conventional energy sources; Importance of new and renewable energy sources in the present energy scenario and types of resources.	5
2.	Small Hydro Power potential and classification of SHP projects; Basic components of civil works; Selection of electro-mechanical equipment.	8
3.	Estimation of Biomass resources, Biomass Technologies for thermal and biological conversion; Biomass based electricity generation and application of bio fuels.	6
4.	Solar energy estimation and different routes of solar energy applications; Technologies for solar thermal power generation; Photovoltaic power generation system.	8
5.	Estimation of wind energy potential and site selection; Types of wind mills, their basic characteristics and applications; Recent technologies of wind energy conversion system (WECS), wind farms.	8
6.	Ocean energy-potential, methods of harnessing; Geothermal energy; New technologies for renewable energy; Integrated renewable energy systems.	7
Total		42

11. Suggested Books:

Sl. No.	Name of Authors/Title/Publisher	Year of Publication/ Reprint
1.	Ramchandra Nair, P.K. "An Introduction to Agroforestry" (1 st Edition), Springer (India) Private Limited.	2008
2.	Lysen, "Introduction to Wind Energy", Georgia Institute	1998
3.	ICIMOD, "Small Hydro Design Manuals, Vol. I to IV", AHEC Publication.	1998/2005
4.	Godfrey Boyle, (Editor) "Renewable Energy Power for a Sustainable Future", (2 nd Edition), Oxford University Press.	2010
5.	Sukhatme, S.P., "Solar Energy Principles of Thermal Collection and Storage"- (2 nd Edition), Tata McGraw Hill	1996
6.	Clare, R., "Tidal Power : Trends and Development", Thomas Telford	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: DEPARTMENT OF EARTHQUAKE ENGINEERING

1. Subject Code: **IEQ-303** Course Title: **EARTHQUAKE GEOLOGY & GEOINFORMATICS**

2. Contact Hours: **L: 03** **T: 00** **P: 00**

3. Examination Duration (Hrs.): **Theory 3** **Practical 0**

4. Relative Weightage: **CWS 25** **PRS 0** **MTE 25** **ETE 50** **PRE 0**

5. Credits: **3** 6. Semester: **Autumn & Spring** 7. Subject Area: **ESC**

8. Pre-requisite: **Nil**

9. Objective: This course aims to provide required knowledge and training for the engineering activity related to Earthquake geology and use of Geoinformatics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Earthquakes and tectonics: Earthquakes, characteristics and distribution, causes of earthquakes, tectonic features of the earth, geologic hazards perception.	6
2.	Remote Sensing in Earthquake Geology: Basic concepts of satellite imaging of ground, Satellite data in identifying the tectonic features, Recognising characteristics of earthquake deformation features, SAR Interferometry for earthquake deformation studies.	9
3.	Mapping: Introduction to topographical and geological maps, Application of GPS for mapping and the concept.	4
4.	GIS in Earthquake Geology: Basic GIS concepts, Vector and Raster data understanding, Database creation for geological, tectonic and earthquake themes, GIS data integration and analysis techniques.	9
Total		28

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Goodman, R.E., "Engineering Geology," Wiley, New York.	1993

2.	Ramsay, J.G. and Huber, M.I., "The technique of modern structural geology," Vol 2: Folds and Fracture. Academic Press, London.	1987
3.	Moore, E.M., and Twiss, R.J., "Tectonics," W.H. Freeman and Company, New York.	1995
4.	Yeats, R.S., Sich, K. and Allen, C.R., "Geology of Earthquakes," Oxford University Press, New York.	1997
5.	Lillesand, T. M., "Remote Sensing and Image Interpretation," John Wiley and Sons.	1979
6.	Gupta, R.P., "Remote Sensing Geology," Springer-Verlag press, Berlin	2002
7.	Burrough, P.A., "Principles of Geographic Information Systems for Land Resources Assessment," Oxford Univ. Press.	1986

**INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
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NAME OF DEPTT / CENTRE : Department of Chemistry

1. Subject Code: **ICY-301** Course Title: **Fundamentals of Polymer Science**
2. Contact Hours: **L: 2** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory: 2** **Practical: 0**
4. Relative Weightage: **CWS : 25** **PRS : 0** **MTE: 25** **ETE : 50** **PRE: 0**
5. Credits: **3** 6. Semester: **Autumn/Spring** 7. Subject Area: **BSC**
8. Pre-requisites: **Nil**
9. Objective: To introduce the fundamentals and technological importance of polymers.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: General ideas of the polymers and their classifications, molecular forces and chemical bonding: Polymers in technological and biomedical fields.	4
2.	Polymer Chains and Molecular weights: Degree of polymerization, number and weight average molecular weights; Molecular weight dispersity and characteristics of polymers; Weight and composition heterogeneity in polymers; Polymer chain dimension and solution viscosity; Thermal and spectral characteristics of polymers.	6
3.	Methods of Polymer Synthesis: Synthesis of polymers using bulk, solution, emulsion, suspension, interfacial route of polymerization and characteristics of polymers. Addition and step growth polymers.	6
4.	Technological Polymers: Polymer blends, polymer composites, polymer films, resins, foams, polymer liquid crystals, and engineering plastics, smart and responsive polymers, polymers for device applications, biodegradable polymers, conducting polymers.	6
5.	Industrial Polymers: Vinylic and phenolics, polyesters, polyamides, polyphosphazenes, polysilanes, polysiloxanes, coordination and organometallic polymers, polyacrylates.	6
Total		28

11. Suggested Books:

S. No.	Authors/Name of Books/Publisher	Year of Publication/Reprint
1.	Billmeyer Jr. F.W., " Text Book of Polymer Science " 3 rd Ed. Wiley-InterScience.	1994
2.	Fried J.R., " Polymer Science and Technology ", Prentice-Hall of India.	2002
3.	Stevens M.P., " Polymer Chemistry: An Introduction ", 3 rd Ed., Oxford University Press.	1999

4.	Seymour R.B. and Carraher Jr C.E., " Polymer Chemistry ", Marcel-Dekker.	1991
5.	Sinha R., " Outlines of Polymer Technology: Manufacture of Polymers ", Prentice-Hall of India.	2000

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

1. Subject Code: **ICY-303** Course Title: **Introduction of Photochemistry**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs): **Theory 2 Practical 0**

4. Relative Weightage: **CWS 25 PRS 0 MTE 25 ETE 50 PRE 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area:

8. Pre-requisite:

9. Objective: **The objective of the course is to learn photochemistry concepts related to physical processes and chemical reactions induced by proton absorption and their applications.**

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Electromagnetic radiation, color, electronic states, absorption and emission. Excited states and photophysical processes, annihilation, emission, and sensitization. Jablonski diagrams, excited state lifetimes, fluorescence and phosphorescence and quantum yield.	4
2	Photophysical Processes: Intramolecular radiationless transitions of excited states energy gap law, Frank-Condon factor, intersystem crossing, heavy atom effects and selection rules. Intermolecular physical processes of excited states – quenching, excimers, exciplexes, electronic energy transfer and photoinduced electron transfer.	8
3	Photochemical reactions: Classification of photochemical reaction pathways, and mechanisms – electron transfer and proton transfer, photochemical intermediates, photoisomerizations, chemiluminescence, bioluminescence and related processes. Chemistry of excited state molecules (alkenes, aromatics, ketones, molecular oxygen etc.). Photosensitizers, photoinitiators and photocatalysts.	9
4	Photochemical devices: Photochemical molecular machines, photodynamic therapy applied to cancer, photochromatic imaging, photostabilizers, fluorescent sensors, polarity probes, switches, light emitting diodes and photovoltaics.	7
	Total	28

Recommended Books:

Photochemistry of Organic Compounds: From Concepts to Practice, P. Klan and J. Wirz, Wiley-Blackwell, 2009.

Molecular Fluorescence: Principles and Applications, B. Valeurm, Wiley, 2002.

Introduction to Organic Photochemistry, J.D. Coyle, John Wiley & Sons, 1991.

Principles of molecular photochemistry: an introduction, Nicholas J. Turro, V. Ramamurthy and Juan C. Scaiano, University Science Books, 2008.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: Chemistry Department

1. **Subject code:** ICY-305 **Course Title:** Theoretical Aspects of Polymers
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Spring /Autumn **7. Subject Area:** OEC
8. **Pre-requisite:** NIL
9. **Objective:** To familiarize students with the basic theoretical concepts of polymers.

10. Details of the Course:

S. No.	Contents	Contact Hours
	Statistical Thermodynamics: Microstates, Ensembles-microcanonical, canonical, grand-canonical, Partition functions, distributions, Averages, thermodynamic connection, probability distribution of fluctuations	6
1.	Chain Statics: Characteristic dimensions of 'random coil' polymers, models for calculating the average end-to-end distance for an ensemble of statistical chains, distribution of end-to-end vectors, Worm-like chain, measurement of radius of gyration from scattering, free energy of ideal chain, scaling arguments for stretching and confinement, pair correlation for ideal chain, structure factor.	12
2.	Real chains: Excluded volume, self-avoiding walks, deforming real and ideal chains, scaling model for real chains, Flory theory, solvent quality, theta-temperature. Thermodynamics and statistical mechanics of polymer networks.	8
3.	Polymer solutions: Thermodynamics of mixing, Flory-Huggins theory, osmotic pressure, concentration regimes in polymer solutions, correlation length, correlation function, screening of excluded volume forces, size of a polymer in semi-dilute solutions, polymer-polymer blends and phase diagrams.	9
4.	Polymer melts: chains in melts, screening in dense polymer melts, correlation hole.	3
5.	Polymer dynamics: Rouse model, Zimm model, reptation	4
	Total	42

11. Suggested Books:

S. No.	Name of Authors/Book/ Publisher etc.	Year of Publication/ Reprint
1	Fredrickson G., "The Equilibrium Theory of Inhomogeneous Polymers", Oxford University Press.	2013
2	Kawakatsu T., "Statistical Physics of Polymers: An Introduction", Springer	2013
3	Doi M., Edwards S.F., "The Theory of Polymer Dynamics", The International Series of Monographs on Physics, vol. 73, Oxford: Clarendon Press.	2013
4	Gedde U., "Polymer Physics", ebook, Dordrecht: Springer Netherlands.	2013
5	Strobl G. R., "The Physics of Polymers: Concepts for Understanding Their Structures and Behavior", 3 rd Ed., Berlin; London : Springer.	2011
6	Flory P. J., "Principles of Polymer Chemistry", 1 st Ed. publ. 1953, 20 reprint, Ithaca: Cornell University Press.	2010
7	de Gennes P.G., "Scaling Concepts in Polymer Physics", 1 st Ed., Ithaca, NY: Cornell University Press.	2005
8	Rubinstein M., Colby R. C., "Polymer Physics", 1 st Ed., Oxford University Press.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE: **DEPARTMENT OF EARTHQUAKE ENGINEERING**

1. Subject Code: **IEQ – 301** Course Title: **INTRODUCTION TO EARTHQUAKE ENGINEERING**
2. Contact Hours: **L: 03 T:00 P:00**
3. Examination Duration (Hrs.): **Theory: 03 Practical: 00**
4. Relative Weightage: **CWS:25 PRS:00 MTE:25 ETE:50 PRE;00**
5. Credits: **03** **6.Semester: Autumn & Spring**
7. Pre-requisite: Nil
8. Subject Area: **OEC**
9. **Objective of Course:** To introduce the fundamentals of seismology and its civil engineering relevance.
10. Details of Course:

Sl. No.	Particulars	Contact Hours
1.	Time dependent phenomena and the nature of earthquake loading and ground motion characteristics.	2
2.	Dynamics of Single Degree of Freedom System: Dynamic equilibrium, equation of motion, free vibration: natural frequency and damping, forced vibration, response to harmonic excitation, application to design of vibration transducers and vibration isolators.	10
3.	Response to transient excitation, impulse response and convolution (Duhamel) integral, response spectrum.	4
4.	Dynamics of Multi-Degree of Freedom System: Equations of motion, free vibration characteristics: natural frequencies, modal damping and normal modes, orthogonality of normal modes, mode superposition method for dynamic analysis with response spectrum	10
5.	Experimental structural dynamics, experimental modal analysis	2
	Total number of lectures	28

11. **Suggested Books:**

Sl. No.	Name of Books/Authors/ Publishers	Year of Publication/ Reprint
1.	Agrawal, P. and Shrikhande, M., "Earthquake Resistant Design of Structures," PHI Learning Pvt. Ltd, New Delhi.	2006
2.	Chopra, A.K., "Dynamics of Structures," 4th edition, Prentice-Hall, Inc.	2011
3.	Humar, J.L., "Dynamics of Structures," 3rd edition, CRC Press.	2012
4.	Craig, R.R. Jr. and Kurdila, A.J., "Fundamentals of Structural Dynamics," 2nd edition, John Wiley & Sons, Inc.	2006
5.	Villaverde, R., "Fundamental Concepts of Earthquake Engineering," CRC Press.	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: DEPARTMENT OF EARTHQUAKE ENGINEERING

1. Subject Code: **IEQ-303** Course Title: **EARTHQUAKE GEOLOGY & GEOINFORMATICS**

2. Contact Hours: **L: 03 T: 00 P: 00**

3. Examination Duration (Hrs.): **Theory 3 Practical 0**

4. Relative Weightage: **CWS 25 PRS 0 MTE 25 ETE 50 PRE 0**

5. Credits: **3** 6. Semester: **Autumn & Spring** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: This course aims to provide required knowledge and training for the engineering activity related to Earthquake geology and use of Geoinformatics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Earthquakes and tectonics: Earthquakes, characteristics and distribution, causes of earthquakes, tectonic features of the earth, geologic hazards perception.	6
2.	Remote Sensing in Earthquake Geology: Basic concepts of satellite imaging of ground, Satellite data in identifying the tectonic features, Recognising characteristics of earthquake deformation features, SAR Interferometry for earthquake deformation studies.	9
3.	Mapping: Introduction to topographical and geological maps, Application of GPS for mapping and the concept.	4
4.	GIS in Earthquake Geology: Basic GIS concepts, Vector and Raster data understanding, Database creation for geological, tectonic and earthquake themes, GIS data integration and analysis techniques.	9
Total		28

11. Suggested Books:

Sl. No.	Name of Books/Authors	Year of Publication
1.	Goodman, R.E., "Engineering Geology," Wiley, New York.	1993
2.	Ramsay, J.G. and Huber, M.I., "The technique of modern structural geology," Vol 2: Folds and Fracture. Academic Press, London.	1987
3.	Moore, E.M., and Twiss, R.J., "Tectonics," W.H. Freeman and Company, New York.	1995
4.	Yeats, R.S., Sich, K. and Allen, C.R., "Geology of Earthquakes," Oxford University Press, New York.	1997
5.	Lillesand, T. M., "Remote Sensing and Image Interpretation," John Wiley and Sons.	1979
6.	Gupta, R.P., "Remote Sensing Geology," Springer-Verlag press, Berlin	2002
7.	Burrough, P.A., "Principles of Geographic Information Systems for Land Resources Assessment," Oxford Univ. Press.	1986

**INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE**

NAME OF THE DEPTT/ CENTRE: **Earth Sciences**

1. Subject Code: **IES-04** Course Title: **Planetary Geosciences**

2. Contact Hours : **L-2** **T-1** **P-0**

3. Examination Duration (Hrs): **Theory:** **Practical:**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits : 6. Semester: **Both** 7. Subject Area: **BGSEC**

8. Pre-requisite: **Nil**

9. Objective: To provide insight into geophysical and geological attributes of planets and satellites

10. Details of Course:

S. No	Contents	Contact Hours
1	Solar system, planets and natural satellites, exploration of solar system, basic data and summary of spacecraft missions	2
2	Physical field mapping of planets, gravity and magnetic field mapping through artificial satellites, remote sensing and radar altimetry	3
3	Planetary geology, geological aspects of earth like planets of solar system Role of remote sensing techniques including understanding of surface morphology of planets	5
4	Spherical and ellipsoidal harmonic analysis, toroidal and poloidal functions, physical significance	5
5	Gravity potential mapping of different planets, multipole expansion of magnetic potential and physical significance. MAGSAT and SEASAT results for earth	5
6	Inference of presence of water pockets using magnetic resonance sounding in terrestrial planets and moons	5
7	Planetary magnetism, magneto-variation data inversion for reconstructing planet's electrical conductivity variation. Internal dynamo theories and core dynamics.	3
8	Heat flux, thermal structure, mantle convection. Understanding of source for plate tectonics.	2
	Total	30

11. Suggested Books:

S. No	Name of Books/ Authors	Year of Publication
1	Faure, G. and Mensing, T.M., "Introduction to planetary science", Springer	2007
2	Cole, G.H.A. and Woolfron, M.M, Planetary science: The science of planets and stars', CRC Press	2002
3	Imke de Pater and Lissauer, J.J., "Planetary sciences", Cambridge University Press	2001
4	Backus, G., Parker, R.L. and Constable, C, " Foundations of Geomagnetism" Cambridge University Press	1996
5	Greeley, R. and Batson, R.M., "Planetary mapping" Cambridge University Press	1990
6.	Littman, M, "Planets beyond", John Wiley & Sons	1990

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF THE DEPARTMENT: **EARTH SCIENCES**

1. **Subject Code: IES-05**

Course Title: Glaciology

2. Contact Hours : **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs): **Theory** **Practical**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits :

6. Semester: **Both**

7. Subject Area: **BGSEC**

8. Pre-requisite: **Nil**

9. Objective: To impart knowledge of glaciers, processes and impacts of climate.

10. Details of Course:

S. No	Contents	Contact Hours
1.	Snow deposition, mineralogy of ice, metamorphism of ice, glaciers and their classifications, geographical distribution of glaciers, glacio-hydrological regimes of India	5
2.	Principles of mass balance and different techniques of glacier mass balance .	4
3.	Various methods and techniques to raise an ice core, down core variation of hydrochemistry including isotopic changes, various technique to date ice cores and assessment of impact of climate changes.	7
4.	Glacier motion/flow, various physical processes (erosion, transportation and deposition of sediments), changes in glaciated area through time, active processes within glaciers	5
5.	Melt water/runoff generation, hydrograph separation to delineate melt water contribution in surface flow and groundwater, sources of moisture for glacier accumulation.	5
6.	Basic techniques for glacier expedition, rescue, hazard recognition and avoidance	4
	Total	30

11. **Suggested Books:**

S. No	Name of Authors/ Books/ Publishers	Yr of Pub.
1.	Frederic P. Miller, Agnes F. Vandome and John McBrewster, "Glaciology: Glacier, Earth science, Geophysics, Geology, Physical geography, Climatology, Meteorology, Hydrology, Biology, Ecology" McBrewster	2010
2.	Shi Yafeng "Collectanea of the Studies on Glaciology, Climate and Environmental Changes in China",	2008
3.	Bryn Hubbard and Glasser N. F, "Field Techniques in Glaciology and Glacial Geomorphology" Wiley Pub.	2005
4.	Aber J. S. and Croot D G. "Glaciotectonic Landforms and Structures (Glaciology and Quaternary Geology)", Springer	1989
5.	Shumskiy P A, "Dynamic Glaciology ", Amerind Publishing Co	1978

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE : **DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES**

1. Subject Code: **IHS-09** Course Title: **Science, Technology and Society**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits: 6. Semester: **Both** 7. Subject Area: **HSSMEC**

8. Pre-requisite: **Nil**

9. Objective:

To provide a basic understanding and an in-depth discussion of issues that fall under broader spectrum of inter-relationship between science, technology and society.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Introduction to Sociology, sociological imagination, the two revolutions and their socio-economic, technological and scientific implications	4
2.	Social significance of science and technology, ideas beyond technology, perspectives on relations between science and technology	4
3.	Sociological perspective on scientific knowledge: Karl Marx, Emile Durkheim and Karl Mannheim's Sociology of knowledge.	5
4.	Merton's approach to science and technology: ethos of science, Matthew effect in Science, Thomas theorem and Matthew effect	4
5.	Thomas Kuhn's notions of paradigm and paradigm-based science, scientific community and growth of scientific knowledge	3
6.	Science in India: science and technology policies in India; scientific communities and their linkages, national and international. science and	5
7.	Ethics in science & engineering, environment and science and technology	3
	Total	28

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Frederic A. Lyman: Opening Engineering Students' Minds to Ideas Beyond Technology. IEEE Technology and Society Magazine, Fall, p.16-23.	2002
2.	John Theodore Rivers: Technology and the Use of Nature. Technology in Society, 25 (3), August, p. 403-416.	2003
3.	Robert K. Merton: The Matthew Effect in Science: The reward and communication systems. Science, 159(3810), January 5, p. 56-63.	1988
4.	Robin Williams and David Edge: The social shaping of technology. Research Policy, Volume 25, Issue 6, September 1996, p. 865-899.	1996
5.	Ronald R Kline: Using History & Sociology to Teach Engineering Ethics. IEEE Technology and Society Magazine, Winter, p. 13-20.	2002
6.	V.V. Krishna: A portrait of the scientific community in India: Historical growth and contemporary problems, Gaillard et al. (eds). Scientific Communities in the Developing World, Sage	1997



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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE: **Mathematics Department**

1. Subject Code: **IMA-301** Course Title: **Advanced Engineering Mathematics**

2. Contact Hours: **L: 3 T: 0 P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits: 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **None**

9. Objective: To impart knowledge of essential mathematical tools of complex variables, partial differential equations and calculus of variations to engineering students.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Functions of a Complex Variable: Analytic functions, conjugate harmonic functions, applications to the problems of potential flow.	6
2.	Conformal Mapping: Bilinear transformations, Schwartz-Christoffel transformations and their applications to engineering problems.	6
3.	Complex Integration: Line integrals, Cauchy integral theorem, Taylor's and Laurent's expansions, zeros and singularities, Cauchy residue theorem, contour integration and its applications.	10
4.	Partial Differential Equations: Solution of first order quasi linear equations, four standard forms of PDE, solution of first order non-linear PDE using Charpit's method, solution of linear equations with constant coefficients, classification of second order PDE, solution of one dimensional wave and diffusion equations, Laplace equation in 2 and 3 dimensions.	12
5.	Calculus of Variations: Functionals, Euler's equations for one and several variables, isoperimetric problems, sufficient conditions for weak and strong maxima and minima, applications.	8
	Total	42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	Brown, J. A. and Churchill, R. V., Complex Variables and Applications , 6 th Edition, Mc Graw Hill.	1996
2.	Prasad, C., Advanced Mathematics For Engineers , Prasad Mudralaya.	1991
3.	Grewal, B. S., Higher Engineering Mathematics , Khanna Publishers.	2005
4.	Kreyszig, Erwin, Au., Advanced Engineering Mathematics , 8 th Edition, John Wiley.	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE : **PHYSICS DEPARTMENT**

1. Subject Code: **IPH-07** Course Title: **Reactor Physics**
2. Contact Hours: L: **3** ; T: **0** ; P: **0** ;
3. Examination Duration (Hrs.): Theory Practical
4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**
5. Credits: 6. Semester:
- Autumn Spring Both
7. Pre-requisite: **PH-101** 8. Subject Area: **BGSEC**

9. **Objective of Course:** To provide comprehensive knowledge on nuclear reactor physics and its technological aspects.

10. Details of Course:

S.No.	Particulars	Contact Hours
1.	Nuclear Physics: Fundamental particles, structure of nuclei; Binding energy, nuclear stability and radioactive decay, nuclear reactions.	6
2.	Interaction Radiation with Matter: Neutron interactions, energy loss in scattering collisions, fission, Gamma-ray interactions with matter, charged particles.	6
3.	Nuclear Reactors and Nuclear Power: Fission chain reactions, reactor fuels, nuclear power resources, power plants, nuclear reactors.	6
4.	Neutron Diffusion and Moderation: Neutron flux, diffusion equation and its solution, thermal neutron diffusion.	6
5.	Nuclear Reactor Theory: one-group reactor equation, slab reactor, thermal reactor, reflected reactor.	6
6.	Time-Dependent Reactor: Reactor kinetics, temperature effects on reactivity, fission product poisoning.	6
7.	Heat Removal from Nuclear Reactors: Heat generation in reactors, heat flow in reactors, heat transfer mechanisms. Radiation Shielding: Gamma-Ray shielding, nuclear reactor shielding.	6
	Total	42

11. Suggested Books:

S.No.	Names of Books/Authors	Year of Publication
1.	LeRoy Murray Raymond, " Nuclear Reactor Physics ", Prentice Hall	2000
2.	R. Lamarsh John, J. Baratta Anthony, " Introduction to Nuclear Engineering ", Wiley-Interscience.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: Civil Engineering

1. **Subject code:** ICE-302 **Course Title:** Simulation of Behaviour Induced Mobility
2. **Contact hours:** **L:** 3 **T:** 0 **P:** 2
3. **Examination duration (hrs):** **Theory:** 3 **Practical:** 0
4. **Relative weightage:** **CWS:** 10-25 **PRS:** 25 **MTE:** 15-25 **ETE:** 30-40 **PRE:** 0
5. **Credits:** 3 6. **Semester:** Both 7. **Subject area:** OEC
8. **Pre-requisite:** Basic knowledge of object-oriented programming
9. **Objectives of the course:** To make students familiar with the development of algorithms and application of simulation tools in the field of mobility modelling and simulation.

10. Details of the course:

S. No.	Contents	Contact hours
1	Introduction to Modeling and Simulation: Importance and necessity of the simulation in traffic and transportation, brief comparison of various available software and their limitations, discrete vs continuous simulation, micro/meso/macrosopic models, advantages and disadvantages of the simulation	4
2	Basics of mobility systems: Characteristics of Traffic flow, relationship between fundamental variables, multi-class fundamental diagrams, mixed traffic; Travel demand modeling, user behavior, utility function, basics of transport economics, demand-supply equilibrium, transport negative externalities	10
3	Data collection, extraction and preparation: traditional techniques in traffic engineering & transportation planning, use of the advanced technologies like Web APIs, CDR, WiFi/Bluetooth sensors, representation of the physical road-network in the model, processing of the collected and extracted data	8
4	Simulation Tools: Modeling – calibration and validation, co-evolutionary algorithms, agent-based models, activity-based models, cellular automata, models for pedestrian simulation, traffic and transport simulation models, suitability for large-scale scenarios	8
5	Network Simulation and evacuation Systems – network loading algorithm, simplified kinematic wave model, computational performances; evacuation behavior, building evacuation, mass-gathering evacuation, evacuation preparedness;	6
6	Mobility simulations and econometrics: accessibility vs mobility, importance and computation of accessibility, shared mobility systems (bicycle/car sharing systems), electric vehicles; congestion, air pollution, on-road air pollution exposure, marginal social cost pricing, dynamic road pricing;	6
	Total	42

List of Laboratory Experiments

- a. Traffic Volume and Intersection! Turning Movement Study
- b. Spot Speed, Travel Time and Delay Study
- c. Origin Destination Study and Household Survey
- d. Extraction of travel time using Web APIs
- e. Scenario preparation
 - i. Network preparation
 - ii. Demand generation
- f. Running an agent-based simulation scenario
- g. Running an evacuation scenario
- h. Running a scenario from accessibility/shared mobility/congestion/air-pollution

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication
1	Jaume Barceló, "Fundamentals of Traffic Simulation", Springer.	2010
2	Stewart Robinson, "Simulation: The Practice of Model Development and Use", John Wiley & Sons. Ltd	2004
3	Stefania Bandini, Sara Manzoni, Giuseppe Vizzari, "Agent based modeling and Simulation"	2012
4	Klügl, Franziska, Bazzan, Ana, Ossowski, Sascha (Eds.), "Application of agent technology in Traffic and Transportation, Springer.	2005
5	Andreas Horni, Kai Nagel, Kay W. Axhausen, "The multi-Agent Transport Simulation", Ubiquity Press, UK	2016
6	May, A.D., "Fundamentals of Traffic Flow", Prentice Hall, Inc. 2nd Ed.	1990
7	Roger P Roess, Elena S Prassas, William R McShane, "Traffic Engineering" 4th Ed, Prentice Hall.	2011
8	Juan de Dios Ortúzar, Luis G. Willumsen, "Modelling Transport", 4th Edition	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF THE DEPARTMENT: **EARTH SCIENCES**

1. Subject Code: **IES-301** Course Title: **FRACTALS AND APPLICATIONS**

2. Contact Hours : **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs): **Theory** 2 **Practical** 0

4. Relative Weightage: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits : 3 6. Semester: **Both** 7. Subject Area: **BGSEC**

8. Pre-requisite: Nil

9. Objective: To introduce the concepts of fractal geometry and its applications.

10. Details of Course:

S. No	Contents	Contact Hours
1.	Mathematical background, self similarity, Sierpinski triangles, Koch curves, cantor sets	4
2.	Box-counting dimensions, Kolmogrov capacity, 1D and 2-D box counting	3
3.	Hausdorff measures and dimension, deterministic and random fractals, natural fractals, iterated function systems, stochastic dynamical systems, compression of images	7
4.	Dynamical systems, interval self-mappings, complex iteration, perturbation theory, geometrical theory, small divisors, deterministic chaos to deterministic division	7
5.	Applications in fragmentation, tectonics, geomorphology, seismology	4
6.	Applications in other fields, image compression, finance, soil mechanics	5
Total		30

11. Suggested Books:

S. No	Name of Authors/ Books/ Publishers	Year of Publication Reprint
1.	Schroeder, Manfred, "Fractals, Chaos, Power laws: Minutes from an infinite paradise", Dover	2009
2.	Ott, Edward, "Chaos in dynamical systems", Cambridge Univ. Press, 2 nd ed.	2005
3.	Falconer, Kenneth, "Fractal Geometry: Mathematical foundations and application", Wiley Pub.	2003
4.	Sprott, Julien Clinton, "Chaos and Time Series Analysis", Oxford Univ. Press	2003
5.	Turcotte, Donald.E., "Fractals and Chaos in Geology and Geophysics", Cambridge Univ Press	1997
6.	Peitgen, Heinz-Otto, Jurgens, Hartmut, Saupe, Dietmar, Maletsky, Evan M., Perciante, Terry & Yunker, Lee E, "Fractals for the classroom", Springer Verlag	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE : **DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES**

1. Subject Code: **IHS-03** Course Title: **Group Dynamics**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory 2 Practical 0**

4. Relative Weightage: **CWS 25 PRS 0 MTE 25 ETE 50 PRE 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **HSSMEC**

8. Pre-requisite: **Nil**

9. Objective:

To familiarize the students with the functioning of individuals in group situation.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Introduction to groups and organization: types of groups and their functions and importance for individual and society.	4
2.	Group Process: conformity, deviance, cohesiveness , cooperation and competition	7
3.	Interpersonal attraction and social relationships: attraction as cognitive justification and measurement issues.	3
4.	Group Communication: social networks and rumors and grapevine	3
5.	Interactive Behavior: conflict and resolution strategies. transactional analysis.	4
6.	Individual and group problem-solving, their relative effectiveness	3
7.	Social influence, impression management, social perception and attribution	4
	Total	28

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Luthans,F. Organizational Behavior, McGraw-Hill Book Co.	1985
2.	Michner, H.A, Delamater, J.D and Schwartz, S.H. Social Psychology, Harcourt Brace Jovanovich Publishers.	1986
3.	Robert A. Baron, & Donn Byrne. "Social Psychology" (10 th Ed.)	2004
4.	Pandey, J.Basic and Applied Psychology, Sage Publications, India, Pvt Ltd.	1988
5.	Stephen P. Robbins. 'Organizational Behavior" (10thEd.). Prentice-Hall of India. Pvt. Ltd.	2004
6.	Semin,G.R and Fiedler,K.Applied Social Psychology, Sage publications, India Pvt Ltd.	1996



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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE : **DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES**

1. Subject Code: **IHS-06** Course Title: **Indian Novel in English**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage: **CWS** 15 **PRS** 0 **MTE** 35 **ETE** 50 **PRE** 0

5. Credits: 3 6. Semester: **Both** 7. Subject Area: **HSSMEC**

8. Pre-requisite: **Nil**

9. Objective:

The course aims at enhancing students' receptivity to perennial human values through an in-depth study of the prescribed novels.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Development of the novel as a genre of literature. Studying the novel and its different aspects—plot, characters, fantasy vs realism, prophecy, rhythm, and technique.	6
2.	Novel and society. History of Indian English Novel. The three Big figures. Development during 1980s. Recent trends.	6
3.	Individual texts—Discussion of minimum three novels shall be taken up in detail. The novels being taken up at present are: <i>i. Ghosh, Amitav, The Calcutta Chromosome</i> <i>ii. Narayana, R.K, The Guide</i> <i>iii. Deshpande, Shashi, Roots and Shadows</i> The novels may be changed as per the needs of the students.	10x3= 30
	Total	42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Forster, E.M., "Aspects of the Nove", Atlantic Publishers	2001
2.	Naik, M.K., "Indian English Literature-1980-2000", Pencraft International	1992
3.	Nabar, Vrinda, "Caste as Woman", Penguin Books	1985
4.	Lodge, David, "The Art of Fiction", Penguin Books	1993
5.	Butalia, Urvashi, "The Other Side of Silence", Duke University Press	2000



19 MAR 2009

INDIAN INSTITUTE OF TECHNOLOGY
DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

1. **Subject Code:** IHS-14 **Course Title:** Fiction of the Indian Diaspora
2. **Contact Hours:** L: 02; T: 01; P: 00
3. **Examination Duration (Hrs.):** Theory Practical
4. **Relative Weightage:** CWS MTE ETE
5. **Credits:**
6. **Semester:** Spring Autumn Both
7. **Pre-requisite:** NIL
8. **Subject Area:** HSSMEC
9. **Objective of the Course:** To familiarize students with the cultural dilemma that the diasporic communities face, and their varied emotional and literary responses to the situation by focusing on three or four internationally acclaimed writers.
10. **Details of the Course**

S. No.	Particulars	Contact Hours
1.	Introduction to fiction. The meaning of the term 'diaspora' and significance of the diasporic fiction.	03
2.	Introduction to the writers and their novels included in the study: the commonalities and the differences.	04
3.	Treatment of the cultural dilemma faced by the migrant communities. Meaning and significance of the terms 'acculturation', 'deculturation' and 'transculturation'.	03
4.	Use of innovative literary devices such as myths, magical realism and the supernatural elements.	03
5.	In-depth analysis of selected novels included in the course: their thematic and stylistic interpretations.	12
6.	The significance, implications and impact of diasporic fiction on culture.	03
	Total	28

11. Suggested Books:

Sr. No.	Name of Books/Authors	Year of Publication
1.	Bhabha, Homi. Location of Culture, London: Routledge.	1994
2.	Brah, Avtar. Cartographies of Diaspora: Contesting Identities. London: Routledge.	2002
3.	Said, Edward. Culture and Imperialism. London: Vintage.	1994
4.	Ro Fludernick, Monika. Ed. Diaspora and Multiculturalism, Common Traditions and New Developments . New York : Rodopi B.V.	2004
5.	Mongia, Padmini Ed. Contemporary Postcolonial Theory : A Reader. New Delhi : Oxford UP.	1996
6.	Nelson, Emmanuel S Ed. Writers of the Indian Diaspora : A Bibliographical Critical Sourcebook Westport : Greenwood Press.	1993

INDIAN INSTITUTE OF TECHNOLOGY
DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

1. **Subject Code:** IHS-15 **Course Title:** Creative Writing in English
2. **Contact Hours:** L: 02; T: 01; P: 00
3. **Examination Duration (Hrs.):** Theory Practical
4. **Relative Weightage:** CWS MTE ETE
5. **Credits:**
6. **Semester:** Spring Autumn Both
7. **Pre-requisite:** Nil
8. **Subject Area:** HSSMEC
9. **Objectives of Course:** To familiarize students with the nature, scope and process of creative writing and to encourage their creative potential.
10. **Details of the Course:**

Sl. No.	Particulars	Contact Hours
1.	Defining creative writing: introduction, choice of words, images. Modes of writing: biographical, travelogue, memoirs	05
2.	Reading and writing poetry; forms, styles, types, rhymes, imagery, symbolism. Important literary terms and various trends: Discussion and seminar	08
3.	Features of short story: character, plot, settings, and prose style	03
4.	Novel and drama; differences; narrative techniques; dialogues. Drama and theatre: history, background, action, plot, protagonist, and conflict. Description, exposition, development and ending. Radio & TV plays. Analysis of some important literary works.	12
Total		28

11.Suggested Reading:

Sl. No.	Author/Book	Year of Publication
1.	Mills, Paul. Creative Writing: Course Book. Routledge.	2006
2.	Jaron, Philip K & Allan b. Lefcowitz. Creative Writer's Hand Book.4 th Edition. Prentice Hall	2004
3.	Bulman, Colin .Creative Writing: A Guide and Glossary to Fiction Writing .Polity Press.	2005
4.	Hudson W.H.: A Background to the Study of Literature . Delhi : OUP	2004.
5.	Carole Kiler Doreski. How to Read and Interpret Poetry. 2nd ed. CUP	2006

Appendix 'C'
Item No. Senate/54.8

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE : **Department of Humanities & Social Sciences**

1. Subject Code: **HS-301** Course Title: **Positive Psychology**

2. Contact Hours: **L: 02 T: 01 P: 0**

3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**

4. Relative Weightage: **CWS : 25 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective of the Course: To help students to identify human strengths and positive emotions that promotes the enhancement of life at individual and group levels.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Positive Psychology: Definitions, history, background and the various perspectives-assumptions and goals.	04
2.	Positive Emotional States: Principles of pleasure, positive and negative affect, happiness--its effects and causes; Well-being, emotional, social and psychological, emotional intelligence (EI) and its different perspectives.	04
3.	Positive Cognitive States: Identifying human strengths through values in action (VIA): Wisdom, courage, humanity, justice, temperance, transcendence; Hope optimism, mindfulness and spirituality.	05
4.	Prosocial Behaviors: Altruism, empathy and forgiveness.	04
5.	Psychological Resilience: Growth and adversity, factors associated with resiliency, savoring, quality of life, transcendence.	04
6.	Positive Self: Self; Self-esteem and self-efficacy-locus of control, defense mechanism.	05
7.	Positive Psychological Therapies: Quality of life therapy, post-traumatic growth-based therapy.	02
	Total	28

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Baumgardner S.R. and Crothers M.K., "Positive Psychology", Pearson Education.	2009
2.	Carr A., "Positive Psychology: The Science of Happiness and Human Strengths", 2 nd Ed., Routledge-Taylor& Francis Group.	2011
3.	Lopez S. J., "The Encyclopedia of Positive Psychology", Wiley-Blackwell Publications.	2009
4.	Peterson C, "A Primer in Positive Psychology (Oxford Positive Psychology Series)", Oxford University Press, USA.	2006
5.	Seligman M, "Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment", Atria Books.	2003


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS-302** Course Title: **Introduction to Philosophy**

2. Contact Hours: **L: 02 T: 01 P: 0**

3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**

4. Relative Weight: **CWS : 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **NIL**

9. Objective: To introduce the key concepts and basic concerns of philosophical approach and relating them to contemporary problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Introduction to philosophy; nature of philosophy; its relations with, and differences from, science, religion, art, and culture.	4
2	Philosophy of Science: Philosophy of science, observation, explanation, problem of induction, problem of demarcation, Thomas Kuhn: paradigm change and scientific revolutions.	6
3	Philosophy of Mind: Mind/body problem, Descartes' dualism, behaviorism, identity theories, functionalism problems, knowledge argument.	6
4	Logic: Argument and inference; truth, validity and soundness; sentence and proposition; argument and explanation: forms and fallacies/dilemma; deduction and induction; Aristotelian logic.	6
5.	Applied Ethics: Contemporary moral problems: human rights, social justice, animal rights, sustainability, environment and climate change, liberty, equality, globalization	6
	Total	28


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11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/Reprint
1.	Blackburn S., "Think! A Compelling Introduction to Philosophy", Oxford University Press.	1998
2.	Chalmers, D. J., "Philosophy of Mind: Classical and Contemporary Readings", Oxford University Press.	2002
3.	Copi I. M., "Introduction to Logic", 14th Ed., Pearson,	2012
4.	James R., "The Elements of Moral Philosophy", 4 th Edition, McGraw Hill.	2002
5.	Ladyman, J., "Understanding Philosophy of Science", Routledge.	2002
6.	Singer, P., "Applied Ethics", Oxford University Press.	1986


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS-303** Course Title: **Issues in Indian Economy**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs): **Theory : 3 Practical : 0**

4. Relative Weight: **CWS : 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: **To acquaint the students with emerging issues in the Indian Economy**

10. Details of Course:

S. No.	Contents	Contract Hours
1	Introduction: Changes in the pattern and structure of Indian economy	2
2	Economic Reforms: Structural adjustment programmes; Liberalization, globalization and privatization; FDI	3
3	Growth, Employment, Poverty, and Inequality: Growth trends in national income and per capita income, various concepts and estimates of poverty, income inequality, problem of unemployment, trends in employment, interface among growth, poverty and employment, poverty alleviation and employment generation strategies	5
4	Population and Human Development: Demographic trends, size of working population and its implications for development; Human Development Index	3
5	Issues in Agriculture: Productivity, technology and R& D expenditure, diversification, price policy, public and private sector investment, agricultural credit, marketing, contract farming, subsidies, water and food security	7
6	Issues in Industry: Growth trends and changing patterns of Indian industries, privatization through disinvestment, new manufacturing policy, SEZs.	4
7	Foreign Trade Performance: Import-export growth, changing pattern and direction of trade, Convertibility of currency, WTO related issues	4
Total		28


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11. Suggested Books

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Economic Survey, Government of India, Ministry of Finance, Annual Issue.	latest
2.	Ghate C., "Oxford Handbook of the Indian Economy", Oxford University Press.	2012
3.	Kapila U., "Two Decades of Economic Reforms: Towards Faster, Sustainable and More Inclusive Growth" Academic Foundation.	2012
4.	Kumar A., "Indian Economy Since Independence: Persisting Colonial Disruption", Vision Books.	2013
5.	Mahajan A., Datt, G., and Sundaram, K.P.M ., " Indian Economy", S. Chand.	2013
6.	Panagariya A. " India: The Emerging Giant" Oxford University Press.	2010


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS-304** Course Title: **Macro-Economic Environment**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs): **Theory : 2 Practical : 0**

4. Relative Weightage: **CWS: 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3**

6. Semester: **Spring**

7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: To enhance the understanding the broader macro-economic factors that tend to influence the economy, businesses and economic prospects.

10. Details of Course:

S.No.	Contents	Contact Hours
1	Introduction: Understanding macro-economic environment, global and Indian macro-economic indicators, economic and non-economic factors governing macro-economic environment.	6
2	Development and Disparities: International and inter-regional issues.	3
3	Demographic Factors: Size, growth rate, age composition, sex composition etc. of population, family size, economic stratification of population, educational level, inflation and employment, implications of demographic factors for international and national macro-economic environment.	4
4	State of Infrastructure: Performance and gaps.	3
5	Macro-Economic Policies: Industrial policy, trade policy, monetary and fiscal policies and their implications for businesses and economy.	4
6	External Sector: Trade, foreign investment, and multilateral and bilateral trade agreements.	5
7	Intellectual Property Rights: Concepts and level of protection, impacts on investment, technology development/absorption and growth.	3
	Total	28


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11. Suggested Books/Databases:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	India Infrastructure Report, Routledge.	Annual Issues
2.	Maskus, K. E., "Intellectual Property Rights in the Global Economy", Peterson Institute.	2000
3.	"Foreign Direct Investment for Development: Maximising Benefits, Minimising Costs : Overview", OECD.	2002
4.	Acharya, S., "Essays on Macroeconomic Policy and Growth in India: Macroeconomic Policy and Growth in India", Oxford University Press.	2008
5.	Paul, J., "Business Environment: Text and Cases", Tata McGraw Hill.	2010
6.	Laurent, C., "Tomorrow's World: A Look at the Demographic and Socio-economic Structure of the World in 2032", Wiley.	2013


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Humanities and Social Sciences**

1. Subject Code: HS- Course Title: **Entrepreneurship Development Strategies**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs): **Theory2 Practical0**

4. Relative Weightage: **CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credits: 3

6. Semester: Autumn

7. Subject Area: **HSSMEC**

8. Pre-requisite: Nil

9. Objective:

The objective of the course is to help the students to understand concept and importance of entrepreneurship and to help them to develop necessary skills to cope with the rigours of an entrepreneur.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Introduction to Entrepreneurship Development: Entrepreneurial Motivation Training through EMT, Objectives, Exercises	8
2.	Source of help for Entrepreneurs: Identification and Selection of Good Business Opportunity: Search for an opportunity and selecting the right product, market Survey and research, Techno-economic feasibility Assessment: Preliminary Project Report (PPR).	4
3.	Raising Money for Your Venture: Sources of Finance, Your Business Plans: Detailed Project Report (DPR), Presenting Your Case for a Term Loan	3
4.	Establishing Your Venture: Selecting Right infrastructure, Buying machinery, Sources of Technology and its Evaluation, Recruiting the Right people, project Implementation	3
5.	You and Your Market: Marketing Management for Small Business, Selling and Sales Promotion	1
6.	Managing for Production and Productivity: Production Management	2
7.	Managing Your Scarce Resources 'FINANCE': Management of Working Capital, Costing, Break-even Analysis: Concept and Implications for planning and Decision making	3
8.	Knowing Your Directions: Management in Small Scale Enterprise, Book Keeping, Financial Accounting for Technical Entrepreneurs, Guidance norms for new entrepreneurs	2
9.	Plans for Survival, Case Studies	2
	Total	28


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Suggested References:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	'A Handbook for New Entrepreneurs', Entrepreneurship Development Institute of India (EDII), Gandhinagar, Oxford University Press	2003
2.	'Developing New Entrepreneurs', Entrepreneurship Development Institute of India (EDII), Gandhinagar	2000
3.	'Trainers' Manual on Developing Entrepreneurial Motivation', National Institute for Entrepreneurship & Small Business Development, New Delhi	2000
4.	'The Entrepreneurial Connection' by Narula, Gurmeet, Tata McGraw-Hill Publishing Company Ltd. New Delhi.	2001


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Name of the Deptt/Centre: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-305** Course Title: **Psycholinguistics**
2. Contact Hours: **L: 02 T: 01 P: 0**
3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**
4. Relative Weight: **CWS : 25 MTE : 25 ETE : 50 PRE : 0**
5. Credits: 3 6.Semester: **Autumn** 7. Subject Area: **OEC**
8. Pre-requisite: **Nil**
9. Objective: The course aims at giving the understanding of basic theories and findings in the study of the psychological processes of language learning, with a focus on the comprehension, production, acquisition, and representation of language.

10. Details of Course:

S.No	Contents	Contact Hours
1.	Introduction: What is psycholinguistics, psycholinguistics theories, mentalists and behaviorist aspects of language learning, speech perception in adults and in infants, speech segmentation in adults and in infants, the internal lexicon.	6
2.	Internal Lexicon: Speech perception in adults and in infants, speech segmentation in adults and in infants.	4
3.	Syntactic processing: Sentence comprehension and memory, discourse comprehension and memory, ambiguity resolution.	4
4	Processes of Language Acquisition: Early language acquisition, later language acquisition, cognitive process and innate mechanism.	4
5.	Neuro-linguistic Programming: Human brain and language learning process, biological foundations of language , natural language processing, Aphasiology and Dyslexia	6
6.	Parsing: Linguistic theories.	2
7.	Bilingualism: Second language acquisition.	2
Total		28


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11. Suggested Books:

S.No	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1	Chomsky, N., "New Horizons in the Study of Language and Mind", Cambridge: Cambridge University Press.	2000
2	Fodor J., Bever A., Garrett T. G. and F. M., "The Psychology of Language: An Introduction to Psycholinguistics and Generative Grammar", McGraw-Hill.	1974
3	Gaskell G., (ed.), "Oxford Handbook of Psycholinguistics", Oxford University Press.	2009
4	Gibbs, R. W., "The Poetics of Mind: Figurative Thought, Language, and Understanding", Cambridge University Press.	1994
5	Pinker S., "The Language Instinct", William Morrow.	1994
6	Steinberg D. D. and Sciarini, N., "Introduction to Psycholinguistics", 2nd Ed., Longman.	2006



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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS-306** Course Title: **Psychology of Self and Personal Growth**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**

4. Relative Weight: **CWS : 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Spring** 7. Subject Area: **OEC**

8. Pre-requisite: **NIL**

9. Objective : To facilitate the understanding of self and planning for personal growth and well-being.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Introduction: Self-Reflection and its Consequences; Self as a psychosocial dynamic processing system; Development of Self-representation during childhood and adolescence; Cultural models of self.	5
2.	Self-related Processes: Self-Awareness; Facilitating Self-Control; Bringing out the Best in the Self; Reducing Egotism and Ego Defensiveness.	5
3.	Emotional and motivational aspects of self: Self evaluation, Self esteem and self enhancement, Self verification; Self regulation; Self-relevant emotions.	5
4.	Self-Disclosure: Concept and its Functions; Self-Understanding: The Johari Window; Barriers to Self-Disclosure; Emotional Expression; Strategies for Emotional Control.	5
5.	Positive Energy: Need and Sources; Positive Reinforcement; Confirmation Behaviors, Managing Relationship; Personal Values and Ethical Choices.	4
6.	Change for Personal Development: Opportunities and Challenges; Stages of Change: Pre Contemplation, Contemplation, Planning, Action, Maintenance, and Termination.	4
Total		28


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11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Carr Alan, "Positive psychology: The Science of Happiness And Human Strengths", Routledge.	2010
2.	Leary M. R. and Tangney J.R., "Handbook of self and identity", Guilford Press.	2003
3.	Leary Mark, "The Curse of Self: Self-Awareness, Egotism and the Quality of Human Life", Oxford University Press.	2004
4.	Reece B. L. and Brandt R, "Effective Human Relations: Personal and Organizational Applications", Houghton Mifflin Company.	2005
5.	Snyder C. R. , Lopez S. and Pedrotti, J. T, "Positive psychology: The scientific and practical explorations of human strengths", Sage.	2011


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS- 307** Course Title: **Organizational Behavior and Human Performance**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs): **Theory : 3 Practical : 0**

4. Relative Weightage: **CWS : 25 PRS : 0 MTE : 25 ETE : 50**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: To familiarize students with Organizational Behaviour and Human Performance so that jobs and people at work can be managed properly

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10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Basic Concepts: Scientific and Human Relation Approach.	02
2.	Personality: Meaning and development of personality, Allport's Trait-Theory of Personality, Freudian and Neo Freudian theory.	05
3.	Motivation: Needs, drives and motives; Work motives; Maslow's Need-Hierarchy theory; Herzberg's Two-Factor theory and Alderfer's ERG Theory.	05
4.	Organizational Communication: Meaning and importance of communication, its process, barriers in communication; Its network and strategies for improving its effectiveness.	04
5.	Leadership: Meaning of leadership; Types of leadership; Contingency theories of leadership, transformational leadership.	04
6.	Selection Process: Interviews; Employment tests; Recruitment and Placement.	03
7.	Performance Evaluation and its methods: Purpose of performance evaluation, problems in performance evaluation, methods of performance appraisal- Rating and ranking method, common errors in performance appraisal.	05
	Total	28


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11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Dessler G. and Varkkey B., "Human Resource Management", 11 th Ed., Person Prentice Hall.	2009
2.	Greenberg J., "Behavior in Organizations", 10 th Ed., Pearson Education.	2010
3.	Mamoria C.B. and Pareek U., "Personnel Management: management of Human Resource", 12 th Ed., Himalaya Publishing House.	1999
4.	Morgan C.T., King R.A., Weiz J.R and Schopler J., Introduction to, Psychology", 7 th Ed., Tata McGraw-Hill.	2009
5.	Baron R. A., "Psychology", 5 th Ed., Prentice Hall of India Pvt. Ltd.	2003
6.	Wilson J.P., " Human Resource Development", 2 nd Ed., gan Page Ltd.	2005


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT/CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-308** Course Title: **Gender and Culture Studies**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**

4. Relative Weight: **CWS: 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: To enhance students' understanding of gender and culture and to broaden their perception of these categories in an international context.

10. Details of Course:

Sl. No.	Contents	Contract Hours
1	Introduction: Development of Gender Theories, Correlation between Gender and Culture Theories, History and Concept of Feminism, Understanding Post-modernism and its Intersection with Feminist Theories, Fracturing Binarisms. Discussion of relevant texts.	6
2	Theories of the Construction of Gender: Materialist and Discursive Theories, Gender and Language. Discussion of relevant texts.	4
3	Gender and Society: Gender as a Social Construct, Gender differences and inequalities, Gender and/as Caste, Class, Family, Work, Property Rights. Discussion of relevant texts.	4
4	Gendered Identities: Role of Gender in Individual Cognition of Social Roles, Production of Masculinity and Femininity, Experience vs. Institution, Understanding third Genders. Discussion of relevant texts.	6
5	Culture through Gender: Post-modernist Cultural Theories, Impact of Culture on Women's Movements. Discussion of relevant texts.	4
6	International Issues: Migration and Women, Multiculturalism, Gender and Media Representation, Gender and Science/Technology. Discussion of relevant texts.	4
Total		28


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11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Alsop R., Fitzsimous A., and Lennon K., "Theorizing Gender", Blackwell Publishers.	2002
2.	Barker C. "Cultural Studies: Theory and Practice", Sage.	2003
3.	Butler J., "Gender Trouble: Feminism and the Subversion of Identity", Routledge.	1990
4.	De Beauvoir S., "The Second Sex", Penguin Books.	1984
5.	Glover, D and Kaplan C. "Genders", (Ed.), Routledge.	2000
6.	Jackson S. and Scott S., "Gender: A Sociological reader", (ed.), Routledge.	2002
7.	Mary W., Donna G., Mary B., Hatice O., and Wayne, M., "Women, Science and Technology: A Reader in Feminist Science Studies", 2 nd Ed. , Routledge.	2009


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HS-309** Course Title: **Concept and Practices of Leadership**

2. Contact Hours: **L: 2 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory : 2 Practical : 0**

4. Relative Weight: **CWS : 25 PRS : 0 MTE : 25 ETE : 50 PRE : 0**

5. Credits: **3** 6. Semester: **Spring** 7. Subject Area: **OEC**

8. Pre-requisite: **NIL**

9. Objective: To help students learn the concepts and skills of leadership for improving their managerial potential.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Introduction: Nature of Leadership, Leaders and Managers; Subordinates' Characteristics; Leaders' Characteristics; Abilities, Skills, Dispositions, Roles and Styles, Key Processes; Influencing, Motivating, Enabling.	5
2.	Traditional theories of Leadership: The Great Man theory, Authoritarian and democratic leadership, The Ohio State and Michigan University studies, LPC and Situational Favorableness, Path goal leadership theory, Vroom-Yetton theory, Hersey and Blanchard's Life cycle or situational approach.	4
3.	Modern approaches to Leadership: Implicit Theory of Leadership, Transactional and Transformational Leadership, Charismatic Leadership, Leader-member exchange, Servant leadership, Authentic leadership, Level 5 leadership.	5
4.	Cultural Perspectives on Leadership: Pioneering-innovative (PI) style, Nurturant Task- Participative (NT-P) model, B-C-D theory	6
5.	Emerging Perspectives on Leadership: Internality, Creativity, Humility, Values and Networking; Emotional Intelligence and Leadership; Ethical Leadership; Mentoring, Self-Leadership.	3
6.	Mechanisms for Leadership Development: Recruitment, training and delegation; 360 –Degrees Appraisal; Some Models of Leadership Development; Skill building: Creative problem solving; setting goals, Negotiation, Delegation.	5
	Total	28

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Dayal I., "Can organizations develop leaders: A study of effective leaders", Mittal Publications.	1999
2.	Kanungo R. N. & Mendonca M, "Ethical dimensions of leadership", Thousand Oaks, Sage .	1996
3.	Luthans F, "Organizational Behavior", McGraw-Hill.	2005
4.	Sinha J.B.P, "The cultural context of leadership and power", Sage.	1995
5.	Yukle G, "Skills for managers and leaders", Prentice -Hall.	1990


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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-315 **Course Title:** Psychology of Social Interaction
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To introduce students to various social psychological processes that play salient role during social interaction and decision-making.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Introduction: Concept and definition of Social Psychology, nature and scope; Scientific study of human-social interaction – systematic observations, survey and experimental methods; Application of social psychology to social problems.	3
2.	Personality & Individual differences: Definition and concept of Personality; Role of heredity and environment; Life span development; Sociocultural theories of Personality, Trait theory; The Indian approach to personality; The notion of Self in different traditions; Cognitive styles and individual differences.	6
3.	Emotion and Social interaction: Psychological and physiological basis of Emotion; Theories of Emotion (Classical, Cognitive, and Psycho-physiological theories); Effects of emotion on behavior and social interaction; Emotional competence, emotional intelligence and the related issues.	4
4.	Attitude and Social Judgement: Definition of attitudes, Theories of attitude formation; Components of attitudes; Attitude – behavior Relationship; Definition of Values, Categorization of values; Science of Persuasion, Theories of attitude change; Formation of stereotypes and prejudices; Conformity and obedience.	4
5.	Social Cognition: Schema, Priming, and mental framework of organizing information; Heuristics: availability, anchoring & adjustment; Automatic & Controlled processing of thought; Biases; Affect and social thinking; Attribution, theories of attribution.	6
6.	Interdependence, Attachment, and Interpersonal Relationship: Need to belong, Interdependence theory, Attachment theory; Affect & attraction, Sources of liking; Close relationships, Romantic relationship and Marriage; Love, Jealousy and Infidelity.	5
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Myers, D. G., & Twenge, J. Social Psychology (Eleventh). New York: McGraw Hill.	2013
2.	Branscombe, N. R., & Baron, R. A. Social Psychology (Fourteenth). Pearson Education Limited.	2017
3.	Jakson-Dwyer, D. Interpersonal relationships. Routledge.	2014
4.	Baumeister, R. F., & Finkel, E. J. (Eds.). Advanced social psychology: the state of the science. New York: Oxford University Press.	2010
5.	Schultz, D. P., & Schultz, S. E. Theories of Personality (Eleventh).	2017

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

- 1. Subject Code:** IHS-316 **Course Title:** Medical Humanities
- 2. Contact Hours:** **L:** 2 **T:** 1 **P:** 0
- 3. Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
- 4. Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
- 5. Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
- 8. Pre-requisite:** Nil
- 9. Objective:** To familiarize students with the concepts and different theories of Medical Humanities.
- 10. Details of the Course**

S.No.	Contents	Contact hours
1.	Introduction: Medical Humanities as putatively Interdisciplinary discipline, Interdisciplinary aspects in Humanities	2
2.	The Ethical Aspect of Medical Humanities: Principle of Respect for Autonomy, Principle of Nonmaleficence, Principle of Beneficence, Principle of Justice, genre as social action	6
3.	Literature and Medicine: Connoisseurship of patient, Emotional existence, feminist approach, Patriarchal Approach, biomedical discourse	6
4.	Attention Disorders, Sexual Behavior, Death and Dying, The Mind and its Discontents	6
5.	(Dis)Ability and Literature, the concept of 'other', Exploring Social Issues, Functional Impairment Disability	4
6.	Narrative Medicine: How Writing Can Heal, Patient Narrative & the Real World, Narrative of Double Marginalized	4
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	The Edinburgh Companion to the Critical Medical Humanities, Whitehead A, Woods A	2016
2.	Narrative Medicine: Honoring the Stories of Illness, Charon R	2006
3.	Why Teach Literature and Medicine? Answers from Three Decades. In: New Directions in Literature and Medicine Studies, Jones AH	2017
4.	Medical Humanities: An Introduction, Cole TR, Carlin NS, Carson RA	2014
5.	Personally Speaking: Experience as Evidence in Academic Discourse, Spiegelman C	2004

11. Suggested Books:

S. No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Dominick LaCapra, "Writing History, Writing Trauma". Baltimore: Johns Hopkins	2001
2.	Gyanendra Pandey, "Remembering Partition: Violence, Nationalism and History in India". Cambridge: Cambridge UP	2001
3.	Ritu Menon and Kamla Bhasin, "Borders & Boundaries: Women in India's Partition". New Brunswick, NJ: Rutgers UP	1998
4.	S. Settar and Indira Baptista Gupta, Ed., "Pangs of Partition". 2 Vols, New Delhi: Manohar	2002
5.	Suvir Kaul, Ed. "The Partitions of Memory: The Afterlife of the Division of India". Delhi: Permanent Black	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF THE DEPARTMENT: **HUMANITIES & SOCIAL SCIENCES**

1. **Subject Code:** IHS-324 **Course Title:** Cognitive Ergonomics
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs):** **Theory:** 2 **Practical:** 0
4. **Relative Weight age:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective of Course:** The course provides an understanding of the cognitive abilities of users in the professional work environment.

10. Details of Course:

S. No.	Particulars	Contact Hours
1.	Introduction to Cognitive Ergonomics: Introduction to cognitive science, concept and definition of cognitive ergonomics, approaches to cognitive Ergonomics	04
2	Human Cognitive Abilities and Skills – Perception, Attention, Memory and Learning, Thinking and Language process at work	07
3	Human-Computer Interaction: Human information processing, user-centered design, scenario-based design, personas, monitoring and supervisory control, and class assignments.	04
4	Usability: Definitions of usability by the International Organization of Standardization (ISO) and Nielsen, usability testing, user experience, class Assignments.	06
5.	Human Error Theory & Risk Management: Error, types of human error, the concept of risk and risk management.	04
6.	Cognitive Safety: Cognitive Safety and basic concepts, safety performance measurement, and safety-critical scenarios	03
Total		28

11. Suggested Books:

S. No.	Name of Authors / Books/ Publishers	Year of Publication
1.	Salvendy G., Karwowski W., “Advances in Cognitive Ergonomics”, CRC Press	2017
2.	Veer G.C.V.D., Bagnara S., Kempen G.A.M., “Cognitive Ergonomics: Contribution from Experimental Psychology”, North Holland	1992
3.	Benyon D., “Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design”, Pearson	2013
4.	Norman D., “The design of everything things”, Basic Books	2013
5.	Wickens C.D., Becker S.E.G., Liu Y., Lee J.D., “An introduction to human factors engineering”, Pearson	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE: **Mathematics Department**

1. Subject Code: **IMA-301** Course Title: **Advanced Engineering Mathematics**

2. Contact Hours: **L: 3 T: 0 P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits: 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **None**

9. Objective: To impart knowledge of essential mathematical tools of complex variables, partial differential equations and calculus of variations to engineering students.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Functions of a Complex Variable: Analytic functions, conjugate harmonic functions, applications to the problems of potential flow.	6
2.	Conformal Mapping: Bilinear transformations, Schwartz-Christoffel transformations and their applications to engineering problems.	6
3.	Complex Integration: Line integrals, Cauchy integral theorem, Taylor's and Laurent's expansions, zeros and singularities, Cauchy residue theorem, contour integration and its applications.	10
4.	Partial Differential Equations: Solution of first order quasi linear equations, four standard forms of PDE, solution of first order non-linear PDE using Charpit's method, solution of linear equations with constant coefficients, classification of second order PDE, solution of one dimensional wave and diffusion equations, Laplace equation in 2 and 3 dimensions.	12
5.	Calculus of Variations: Functionals, Euler's equations for one and several variables, isoperimetric problems, sufficient conditions for weak and strong maxima and minima, applications.	8
	Total	42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	Brown, J. A. and Churchill, R. V., Complex Variables and Applications , 6 th Edition, Mc Graw Hill.	1996
2.	Prasad, C., Advanced Mathematics For Engineers , Prasad Mudralaya.	1991
3.	Grewal, B. S., Higher Engineering Mathematics , Khanna Publishers.	2005
4.	Kreyszig, Erwin, Au., Advanced Engineering Mathematics , 8 th Edition, John Wiley.	1999

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Mathematics Department**

1. Subject Code: **IMA-302** Course Title: **Fuzzy Set Theory and Fuzzy Systems**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage: **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 3 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre,requisite: **Nil**

9. Objective: To introduce concepts of fuzzy set theory and its applications in some areas.

S. No.	Contents	Contact Hours
1.	Fuzzy Sets: Concepts of crispness and fuzziness, crisp sets and fuzzy sets, α -cuts, convex fuzzy sets, operations on fuzzy sets, type-2 fuzzy sets, fuzzy numbers and extended operations on them, LR- representations of fuzzy sets and extended operations on them, t-norm and t-conorms, increasing and decreasing generators, interval equations, fuzzy equations.	17
2.	Fuzzy Relations and Fuzzy Graphs: Fuzzy relations on fuzzy sets, composition of fuzzy relations, fuzzy graphs.	5
3.	Fuzzy Analysis: Fuzzy fuctions and their extrema, integration of fuzzy functions, fuzzy differentiation.	5
4.	Fuzzy Logic and Approximate Reasoning: Fuzzy measures and measures of fuzziness, linguistic variables, fuzzy logic, truth tables, approximate reasoning in support logic programming.	5
5.	Expert Systems and Fuzzy Control: Expert systems, uncertainty modeling in expert systems, fuzzy control, pocess of fuzzy control.	5
6.	Decision Making in Fuzzy Environments: Fuzzy decisions, fuzzy linear programming problems, fuzzy transpotation problems, fuzzy dynamic programming, fuzzy multi-criteria analysis.	5
Total		42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	Zimmermann, H. J., Fuzzy Set theory and its Applications , Allied Publishers Limited.	1996
2.	Klir, George J. and Folger, Tina A., Fuzzy Sets, Uncertainty and Information , Prentice Hall of India, Pvt. Ltd.	2003
3.	Klir, Geogrg J. and Bo Yuan, Fuzzy sets and Fuzzy Logic: Theory and Applications , Prentice Hall of India, Pvt. Ltd.	2003
4.	Ross, T.J., Fuzzy Logic with Engineering Aplications , 2 nd Edition, John Wiley & Sons Ltd.	2005
5.	Lai, Y and Hwang, C., Fuzzy Mathematical Programming , Springer - Verlag.	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE: **Mathematics Department**

1. Subject Code: **IMA-303** Course Title: **Robotics & Control**

2. Contact Hours: **L: 3 T: 0 P: 0**

3. Examination Duration (Hrs.): **Theory** **Practical**

4. Relative Weightage: **CWS** **PRS** **MTE** **ETE** **PRE**

5. Credits: 6. Semester: **Both** 7. Subject Area: **OEC**

8. Pre-requisite: **Nil**

9. Objective: To impart the knowledge of basic principles of robot manipulators and their control.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Robotics, Robot manipulators, simple two/three degrees of freedom model.	4
2.	Homogeneous Transformation: Co-ordinate frames, translation and rotation, change of frames, homogeneous transformation, composite homogeneous transformations, general axis of rotation.	6
3.	Kinematics: Link co-ordinate frames, kinematics parameters, the D-H representation, Arm equation.	10
4.	Inverse Kinematics: The inverse kinematics problem, tool configuration, Solution of inverse kinematics problem with examples, trajectory planning and work space analysis.	10
5.	Differential Relationships: Derivative of homogeneous transformation, velocity and acceleration of end-effector, manipulator, Jacobian, dynamical equations control of manipulator dynamics, robotic vision and control.	12
Total		42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	Yoshikawa, Tsuneo, Au., Foundations of Robotics Analysis and Control , Prentice Hall.	1990
2.	Schilling, Robert J., Fundamentals of Robotics: Analysis and Control , Prentice Hall of India.	2005
3.	Ghosal, Ashitava, Robotics: Fundamental Concepts and Analysis , Oxford University Press.	2006
4.	Craig, John J., Introduction to Robotics Mechanics and Control , Pearson Education.	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Centre of Nanotechnology

1. **Subject Code:** INT-301 **Course Title:** Nanodevices
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To provide basic knowledge and a broad overview about various types of nanoscale devices.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Basics of nanotechnology and nanodevices: Introduction to nanoscale materials; nanoscale materials fabrication techniques – lithography, chemical vapor deposition (CVD), atomic layer deposition (ALD), molecular beam epitaxy (MBE), pulsed laser deposition (PLD), solution process, molecular self-assembly; nanomaterials based devices; advantages and challenges of nanodevices	6
2.	Nanoelectronic and nano-optoelectronic devices: Semiconducting nanomaterials and their application to nanoelectronic devices; nanoscale transistors and memory devices; nano-optoelectronic devices – photodetectors, solar cells, light emitting diodes, LASERs and their characterization techniques; molecular devices; nanodevices based on carbon nanostructures – carbon nanotubes (CNT), graphene, and carbon quantum dots	12
3.	Nanosensors and actuators: Fundamental concepts; different types of nanosensors; physical nanosensors: mechanical, thermal, optical, magnetic sensors; chemical nanosensors: gas sensors, opto-chemical, electrochemical sensors; biological nanosensors: electrochemical, CNT based, cantilever based and optical nano biosensors	12
4.	Magnetic nanodevices: Fundamentals of magnetic nanomaterials, domain, magnetic anisotropy; magnetic memory; tunnel junction; spin-valve; spintronics; magnetic nanodevices for medical and environmental applications	6
5.	Nanodevices for healthcare: Nanomedical tools; nanobots; Lab-on chip; nanosensors based smart network for healthcare	6
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/ Reprint
1.	Ramsden, J.; 'Nanotechnology: an introduction'; 2 nd Ed., Elsevier (ISBN: 9780323393140)	2016
2.	Anatoli, K., Goodnick, S., Nemanich, R.; 'Nanoscale materials and devices for electronics, photonics and solar energy'; 1 st Ed., Springer (ISBN: 978-3-319-18633-7)	2015
3.	Khanna, V. K.; 'Nanosensors: physical, chemical and biological'; 2 nd Ed., CRC press (ISBN: 9781000331271)	2021
4.	Rauta, P. R., Mohanta, Y.K., Nayak, D.; 'Nanotechnology in biology and medicine: research advances and future perspectives'; 1 st Ed., CRC press (ISBN: 9780429259333)	2019
5.	Hou, Y., Sellmyer, D. J.; 'Magnetic nanomaterials: fundamentals, synthesis and applications'; 1 st Ed., Wiley (ISBN: 978-3-527-34134-4)	2017

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. / CENTRE : PHYSICS DEPARTMENT

1. Subject Code: **IPH-303** Course Title: **Superconducting Materials and Devices**
2. Contact Hours: L: 3 ; T: 0 ; P: 0 ;
3. Examination Duration (Hrs.): Theory

0	3
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 Practical

0	0
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4. Relative Weightage: CWS

1	5
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 PRS

0	0
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 MTE

3	5
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 ETE

5	0
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 PRE

0	0
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5. Credits:

0	3
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 6. Semester:

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Autumn Spring Both
7. Pre-requisite: Nil 8. Subject Area: OEC
9. **Objective of Course:** The course is designed to introduce the property of superconducting materials and its applications.
10. Details of Course:

S.No.	Particulars	Contact Hours
1.	Characteristic properties of superconducting materials and basic theories: Zero resistance, Meissner effect, critical magnetic field, critical current density, Type-I and Type-II superconductors, isotope effect, flux quantization, thermal properties of superconductors, Heat capacity, Thermal conductivity, Energy Gap, London's equations, outline of Ginzberg Landau theory, outline of BCS theory.	12
2.	Superconducting Materials: Superconducting elements, Binary alloys and compounds, High-T _C cuprate superconductors, C ₆₀ based superconductors, MgB ₂ superconductor, Fe-based superconductors.	05
3.	Processing and Characterization of High T_C Cuprate Superconductors: Familiarization with various techniques of synthesis of HTSC phase of cuprate superconductors in bulk, thin films, single crystals and tape/wires forms. Familiarization with various techniques of electrical, magnetic and structural characterizations of HTSC materials.	08
4.	Critical current of Type-II superconductors: Mixed state, stable and metastable states, the Abriksov lattice, flux flow, flux pinning, flux creep, irreversible properties, depairing critical current, hysteresis cycle: the Bean model, Effects of grain boundaries on J _c in high-T _C superconductors.	06
5.	Josephson effects: The tunnel effect: NIN, NIS and SIS junctions, dc Josephson effect, ac Josephson effect, dc and rf SQUIDS.	06
6.	Technology and Applications: Large scale and high current applications of superconductors, Superconducting Electronics and film applications.	05
Total		42

11. Suggested Books:

S.No.	Names of Books/Authors	Year of Publication
1.	Kittel C., "Introduction to Solid State Physics" John Willey	1996
2.	Rose-Innes A. C. and Rhoderich E. H., "Introduction to superconductivity", Pergamon Press.	1969
3.	Ramakrishnan T.V. and Rao C.N.R., "Superconductivity Today", Pergamon Press.	1992
4.	Michel C. and Davor P., "Introduction to superconductivity and high T _c materials", World Scientific.	1992

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
DEPARTMENT OF PHYSICS

1. Subject Code: **IPH-305** Course Title: **Quantum Computing**
2. Contact Hours: L: T: P:
3. Examination Duration (Hrs): Theory Practical
4. Relative Weightage: CWS PRS MTE ETE PRE
5. Credits:
6. Semester: Autumn Spring Both
7. Pre-requisite: PH-101 or equivalent
8. Subject Area: BGSEC
9. Objective of Course: The aim is to provide comprehensive knowledge on physics and engineering aspects of Quantum Computing.

10. Details of Course:

Sl.No.	Particulars	Contact Hours
1.	Brief history, the postulates of quantum theory, Dirac notation, Density operator and its general properties, Super-dense coding, quantum teleportation and the no-cloning theorem.	8
2.	Quantum computing: Quantum qubits, quantum logic gates, Quantum Circuits, Universal quantum gates, application of quantum computer; Deutsche's algorithm, Deutsch-Jozsa algorithm, Simon's Algorithm, Simulation of quantum system.	12
3.	Quantum Fourier Transform. Grover's algorithm, Phase estimation. Quantum Factorization. Quantum searching, Shor's algorithm, Quantum search algorithms.	12
4.	Quantum error-correction, Quantum error-correcting codes, Stabilizer codes, Fault-tolerant quantum computation, Physical Realizations of Quantum Computation.	10

11. Suggested Books:

Sl.No.	Names of Books/Authors	Year of Publication
1.	Michael A Nielsen and Isaac Chuang, Quantum computation and quantum information, Cambridge University Press.	2012
2.	Phillip Kaye, Raymond Laflamme and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press.	2007

INDIAN INSTITUTE OF TECHNOLOGY
DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

1. **Subject Code:** IHS-323 **Course Title:** Environmental Economics

2. **Contact Hours:** L: 02; T: 01; P: 0

3. **Examination Duration (Hrs.):** Theory Practical

4. **Relative Weightage:** CWS MTE ETE

5. **Credits:**

6. **Semester:** Spring Autumn Both

7. **Pre-requisite:** HS-201 (Economics)

8. **Subject Area:** HSSMEC

9. **Objective of the Course:** To enrich the understanding of the students about various issues related to the economy and environment and endow them with basic concepts and theories of environmental economics with greater emphasis on application

10. **Details of Course**

S. No.	Particulars	Contact Hours
1.	Introduction: Meaning of environmental economics, basic concepts and tools	2
2.	Environment and Development: Poverty, environment, and economic growth, concept of sustainable development	3
3.	Efficiency and Markets: Concept of efficiency, Pareto optimality, efficiency and competitive markets, efficiency in exchange of goods and bads	3
4.	Market Failure and Policy Instruments: Public and private bads, externalities, standards, taxes and subsidies	4
5.	Environmental demand theory: Concept of demand for environmental goods, types of environmental goods, Consumer demand for environmental goods, welfare effects of a price change	3
6.	Environmental Cost-benefit analysis: Meaning, major steps, pollution cost, benefits from controlling pollution, efficiency in pollution control, limitations of cost-benefit analysis	2
7.	Property rights: The rights of polluter and the victim, The Coase Theorem and its policy significance	3
8.	Environmental regulations: Rationale for regulations, basic regulatory instruments, issues and effects of environmental regulations	3
9.	Environmental Policy of India: Objectives, strategy, features, and effectiveness	2
10.	Case Studies	3
	Total	28

11. Suggested Books:

Sr. No.	Name of Books/Authors	Year of Publication
1.	Environmental Economics by Charles D. Kolstad, Oxford university Press, First Indian Edition, New Delhi.	2006
2.	Environmental and Natural Resource Economics by Tom Tietenberg, 7 th ed., Addison Wesley Longman, Inc.,	2006
3	Environmental and Natural Resources Economics: Theory, Policy, and the Sustainable Society by Steven C. Hackett, 3rd ed. M.E. Sharpe, New York	2006
4	Environmental Economics by Ulaganathan Sankar, Oxford University Press	2001
5	Introduction to Environmental Economics by Nick Hanley, Oxford University Press	2001
6	Handbook of Environmental Economics by Daniel W. Bromley Blackwell Publishing	1995
7.	Annual Report of Ministry of Environment and Forests, Government of India, New Delhi	-

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-317 **Course Title:** Power and Politics in Contemporary India: Issues and Approaches
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** This course intends to provide an understanding of various issues related to power and politics in contemporary India.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Approaches to Understand Contemporary India: Indian Perspectives; Functionalist; Marxist; Subaltern; Imperialist; Feminist; Post-Structuralism.	6
2.	Caste and Class Politics: Backward Class Movements; Dalit Politics; Ethnicisation of Caste; OBCs in India, India's Middle Classes, Populism.	6
3.	Development Induced Dispossession and Tribals: Land Dispossession; Tribal-Adivasi Duality; Jal-Jangal-Jameen Politics.	4
4.	Agrarian Crisis: Commercialisation of Agriculture; Neoliberalism and the WTO; Farmers Suicides.	6
5.	Informal Sector: Formal-informal Dualism; Labour and Migration; Right to the City; Precarity; Crisis in Labour Movements.	6
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Satish Deshpande, "Contemporary India: A Sociological View", Penguin Books.	2003
2.	Pulapre Balakrishnan, S. Palshikar and N. Sundar (Eds.), "Reading India: Selections from Economic and Political Weekly", Volume-III (1991-2017), Orient Blackswan.	2019
3.	Jan Breman, "At Work in the Informal Economy of India: A Perspective from the Bottom Up", Oxford University Press.	2016
4.	Nandini Sundar (Ed.), "The Scheduled Tribes and Their India: Politics, Identities, Policies and Work", Oxford University Press.	2016
5.	Dattatreya Narayan Dhanagare, "Populism and Power: Farmers' Movement in Western India, 1980-2014", Routledge.	2016

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-318 **Course Title:** Society, Culture and Development
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 6. **Semester:** Both 7. **Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** The course will familiarize students to a wide variety of theoretical approach to the study of development.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Introduction to the Concept of Development: History, origins, and emergence of the concept of development; Introduction to the sociology of development.	4
2.	Theoretical Approaches to Development: Dependency theories, World system theory, Modernization theories, Actor-oriented theories.	6
3.	Culture and Development: Concept of culture, Cultural institutions and development, Society, community and development.	4
4.	Globalization and Development: Concept and theories of globalization, Inequality and globalization, Globalization and economic transformation in developing countries.	6
5.	Regional Development in India: Development and underdevelopment in India; Development and exclusion in India, Concept of social exclusion and inclusive development, Caste, tribe, gender and social exclusion.	4
6.	Environment and Development: Sustainable development: concept of sustainable development, dimensions and principles of sustainable development; Alternative development: alternative concepts and measures of development.	4
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Pattanaik, B.K. "Introduction to Development Studies". New Delhi: Sage Publications.	2016
2.	Adams, W.M. "Green Development: Environment and Sustainability in a Developing World". Oxon: Routledge.	2009
3.	Shah, A. et. al. "Ground Down by Growth: Tribe, Caste, Class, and Inequality in Twenty-First Century India". New Delhi: Oxford University Press.	2017
4.	Martell, L. "The Sociology of Globalization". Cambridge: Polity Press.	2017

11. Suggested Books:

S. No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Dominick LaCapra, "Writing History, Writing Trauma". Baltimore: Johns Hopkins	2001
2.	Gyanendra Pandey, "Remembering Partition: Violence, Nationalism and History in India". Cambridge: Cambridge UP	2001
3.	Ritu Menon and Kamla Bhasin, "Borders & Boundaries: Women in India's Partition". New Brunswick, NJ: Rutgers UP	1998
4.	S. Settar and Indira Baptista Gupta, Ed., "Pangs of Partition". 2 Vols, New Delhi: Manohar	2002
5.	Suvir Kaul, Ed. "The Partitions of Memory: The Afterlife of the Division of India". Delhi: Permanent Black	2001

11. Suggested Books:

S. No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Arun Mukherjee, "Towards an Aesthetic of Opposition: Essays on Literature, Criticism and Cultural Imperialism". Stratford, ON: Williams-Wallace.	1988
2.	Linda Hutcheon, Ed., "Other Solitudes: Canadian Multicultural Fictions". Toronto: OUP.	1990
3.	Margaret Atwood, "Survival: A Thematic Guide to Canadian Literature". Toronto: House of Anansi.	2013
4.	Thomas King, "A Short History of Indians in Canada". Toronto: HarperCollins.	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Biosciences and Bioengineering

1. **Subject code:** IBE-301 **Course Title:** Introduction to Biosciences
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To impart the knowledge of biological sciences to engineering students and provide perspective and examples on how the interface of biosciences and engineering are changing the world.

10. Details of the Course

S.No.	Contents	Contact Hours
1.	Introduction to Biosciences: The importance and relevance of studying biology, Life at the expense of free energy, Entropic perspective of life, living vs non-living, Origins of life on Earth, Scale in Biology both spatial and temporal	3
2.	Machinery of life: Carbohydrates, Proteins, Lipids and Nucleic acids: Structure and function, Molecular machines, Polymer principles: most macromolecules of life are polymers; variety from a small set of monomers	5
3.	Cell - The structural and functional unit of life: Mesoscale view of a cell, cellular and sub cellular structures, Technologies to visualize cell: Cryo-Electron Microscopy, Super-resolution, Soft X-ray Tomography, and how it links to engineering. Membrane: The protective barrier and trafficking across it, receptors and transporters, endocytosis and exocytosis. Cytoskeleton: Movement in the cell, Motor Proteins, Movement of the cell, Bacterial motors, links to engineering	7
4.	Cellular processes: Building messengers: Transcription, mRNA, microRNA, Building proteins: Translation, Photosynthesis: Production of food and fuel, Cellular Respiration: Release of chemical energy to sustain life, link to engineering: lessons from living systems for making efficient renewable resources, e.g.: solar panels based on photosynthesis in leaves	6
5.	Cell communication: Signalling pathways, Enzymes as biocatalysts and regulation of metabolism, Cell cycle and Cell division, Cell-cell communication, cell adhesion and junctions, Secretory vesicles, hormone release and signalling, Virus attaches and immune response	6
6.	Genetics: Understanding basic concepts of DNA, genes, Chromosomes, Heredity, Mendel's experiments and patterns of inheritance he observed. Mendel's law of segregation and law of independent assortment, Principles of Inheritance: Information processing in living systems, Evolution basics	6
7.	Biosciences and Technology: DNA cloning, DNA sequencing, Genetic engineering, Biomimicry: Drones, Japanese Bullet Train, Velcro tape, Ants and Traffic Jams, Termite mound cooling, Cellular and Urban world, Beetle water collection, Microbiome: Applications in food, health, waste-management, Quantum Biology: Photosynthesis, Bird migration, Enzymatic reactions, Healthcare Technology, Bio-entrepreneurship	9
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/Reprint
1.	Lubert Stryer; Jeremy Berg; John Tymoczko; Gregory Gatto- Biochemistry, Ninth Edition. Publisher: Macmillan Learning	2019
2.	Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Pter Walter, Molecular biology of the cell, 6 th edition. Publisher: Garland Science	2017
3.	Sadava, D. E., D. M. Hillis, et al. Life: The Science of Biology, 11th edition. Publisher: W. H. Freeman	2016
4.	Cell Biology by the numbers (Online free book): http://book.bionumbers.org/	2015
5.	Cecie Starr, Christine A Evers and Lisa Starr, Biology: Concepts and applications. (8th edition, Chapters 1-13 and 15) Publisher: Cengage Learning	2010
6.	Goodsell, D. S. The machinery of life. Publisher: Springer	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Design

1. **Subject Code:** IDN-301 **Course Title:** Sustainable Development Goals and Triple Bottom Line
2. **Contact Hours:** **L:** 2 **T:** 0 **P:** 2
3. **Examination Duration (Hrs.):** **Theory:** 2 **Practical:** 0
4. **Relative Weightage:** **CWS:** 10-25 **PRS:** 25 **MTE:** 15-25 **ETE:** 30-40 **PRE:** 0
5. **Credits:** 3 6. **Semester:** Both 7. **Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To give a perspective of triple bottom line on the basis of sustainable development goals.

10. Details of the Course:

S.No.	Contents	Contact Hours
1.	Introduction: Bottom of the Pyramid, inclusive innovation & Triple Bottom Line (TBL) of sustainability	3
2.	Humanity and the environment, history, and importance of Sustainable Development Goals (SDGs) and TBL	4
3.	Brief overviews of seventeen SDGs, discussion on how seventeen goals are interrelated	6
4.	Mental health and Psychological aspects in design, SDGs, and human rights	5
5.	Case studies: TBL in the product, process, and system design; the role of ethnography, intermediary, CSR, etc.; social impact metrics for engineered products.	10
Total		28

11. List of Practicals:

S.No.	Practicals
1.	Brainstorming for SDG assessment tools
2.	Development of a questionnaire to measure SDGs
4.	Field visits
5.	Report preparation on data collected from field

12. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Robertson, M., Sustainability Principles and Practice, Routledge	2021
2.	Kaltenborn, M., Krajewski, M. and Kuhn, H., Sustainable development Goals and Human rights, Springer	2020
3.	Theis, T. and Tomkin, J., Sustainability: A Comprehensive Foundation, Openstax CNX	2015
4.	Prahlad, C. K., Fortune at the Bottom of the Pyramid: Eradicating poverty through profits, Wharton School Publishing	2004
5.	Henriques, A. and Richardson, J., The Triple Bottom Line: Does It All Add Up, Routledge	2004

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Management Studies

1. **Subject Code:** IBM-322 **Course Title:** Analytics for Managerial Decision Making
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** HSSMEC
8. **Pre-requisite:** Nil
9. **Objective:** To provide skills for applying the traditional statistical and modern machine learning techniques in various managerial decision situations.

10. Details of the Course:

S.No.	Contents	Contact Hours
1.	Recap of Basics of Probability, Descriptive Statistics, Visualizing Data, Concept of a Random Variable, Expectation and Variance of a Random Variable, Properties and distribution of Random Variables	3
2.	Properties of Discrete and Continuous Random Variables, Bernoulli, Binomial, Poisson, Geometric, Uniform, Exponential, Normal	2
3.	Sampling, Simple Random Sample with replacement, Bias in sampling, Interval Estimate for Mean and Proportion, Confidence Intervals for small sample and normal distribution in population, chi-square distribution, t-distribution, f-distribution	5
4.	Hypothesis Testing - Philosophy of Testing, testing for mean and proportion from data, Applications on Real Life Examples	3
5.	Regression Analysis – Linear Regression, Multiple Linear Regression, Detecting and Treating Outliers, Multi-collinearity issues in Regression	4
6.	Logistic Regression, Classification Metrics, Applications in Decision Making	3
7.	Recap of Linear Algebra, Dimensionality Reduction using Principal Component Analysis, Factor Analysis using Python, Singular Value Decomposition	4
8.	Introduction to Supervised and Unsupervised Learning, Cluster Analysis, k-means clustering, Gaussian Mixture Models, Support Vector Machines, Artificial Neural Networks, Applications in Decision Making	8
9.	Text Analytics, Text Processing, Sentiment Analysis, Using ML models on Text data, Examples on Real Datasets	6
10.	Time Series Analysis and Introduction to Reinforcement Learning and its applications	4
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/ Reprint
1.	Shmueli, G., Bruce P., and Patel N.R. ; Data Mining for Business Analytics – Third Edition, Wiley	2016
2.	Bertsimas D., O'Hair A., Pulleyblank W.; The Analytics Edge, Dynamic Ideas LLC	2016
3.	Provost F., Fawcett T.; Data Science for Business; O'Reilly Media	2013
4.	Larose, D. T. and Larose, C. D.; Data Mining and Predictive Analytics”, Wiley	2015
5.	Feller W.; An introduction to probability theory and its applications-Volume 1”, Wiley	2013
6.	Ross Sheldon M.; Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, Elsevier	2014
7.	Taddy M.; Business Data Science: Combining Machine Learning and Economics to Optimize, Automate, and Accelerate Business Decisions, McGraw Hill	2019

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-327 **Course Title:** Women's Writing
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To understand and appreciate new fiction by women writers using narrative theory and new media studies.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Introduction to Feminist Theory: Being/ Becoming, Gender/ Sexuality, Public/ Private, Nature/ Culture, and Binaries of Western thought; Waves of Feminism, Post-Feminism, Eco-Feminism, and Trans-Feminism	4
2.	Writing and Womanhood: Theories of Women's Writing, Essential and Strategic Definitions of Gender, Domesticity, Private Space, Reproductive Labour, Feminist Autonomy, Artistic and Political Freedoms	4
3.	Women's Writing in India: Western Education and its influence, Colonialism and reform, Genres of Women's Writing in India, Life-Writing and Fiction	4
4.	Women's Writing from across the World: World Literature, Translation, Popular and Literary Genres, National Borders and Understanding Fiction	4
5.	From Verbal to Visual: Narrative Theory, Adaptation Theory, Fiction in Print and Electronic Media	4
6.	Comparing Romance Narratives across Media and Nations: Romance and Ideology, Romance and Agency, Conventions and Autonomy, Stereotypes, Gender, and Narrative	4
7.	Female Friendship: Philosophy of Friendship, Male Social Bonding, Female Friendship, Elena Ferrante, Questioning Patriarchal Definitions of Friendship	2
8.	Feminist Dystopia and Science Fiction: Defining Dystopia, Genres of Dystopia including Science Fiction and Feminist Dystopia, Reproductive Agency and Freedom, Utopia and Dystopia, Margaret Atwood's notion of "Ustopia", The Hand Maid's Tale in print and electronic media	2
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/Reprint
1.	Elena Ferrante, My Brilliant Friend, Europa Editions Press	2014
2.	Carole McGann and Seung-kyung Kim, Feminist Theory Reader: Local and Global Perspectives, Routledge	2016
3.	Mieke Bal, Narratology: Introduction to the Theory of Narrative, University of Toronto Press	2017
4.	Margaret Atwood, The Hand Maid's Tale, Penguin Random House	2018
5.	Anuja Chauhan, Baaz, Harper Collins Books	2017
6.	Susie Tharu and K. Lalitha, Women Writing in India, Oxford University Press	2010
7.	Rajeshwari Sunder Rajan, The Scandal of the State: Women, Law, and Citizenship in Postcolonial India, Duke University Press	2013
8.	Uma Chakravarti, Thinking Gender, Doing Gender: Feminist Scholarship and Practice Today, Orient Blackswan	2018

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Humanities and Social Sciences

1. **Subject Code:** IHS-328 **Course Title:** Disability and Literature
2. **Contact Hours:** **L:** 2 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** OEC
8. **Pre-requisite:** Nil
9. **Objective:** To understand the history, theory, and practice of disability studies by reading fictional and non-fictional accounts of illness and care.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Narrative Theory: Defining Narrative, Graphic Medicine, Fictional and Non-fictional Narratives of Illness, Creative and Critical Writings describing medical care	4
2.	Ethics of Care: Feminist Theory and Ideologies of Care, Communities of Care, Medical Humanities	8
3.	Disability Studies: Defining Physical, Intellectual, Social, and Cultural Disability, myth of the “normal” body, Disability Humanism.	4
4.	Postcolonial Public Health: Public Health and the Global South, Imperialism and the origins of modern medicine, Modernity and Medicine, Epidemics and Racial Imagination.	4
5.	Literature, Subjectivity and Illness: Writing and Illness, Description and Healing, Medical and Emotional Care, Literary and Medicinal Truth	8
Total		28

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication/ Reprint
1.	Ato Quayson, <i>Aesthetic Nervousness: Disability and the Crisis of Representation</i> , Wiley Blackwell	2007
2.	Mieke Bal, <i>Narratology: Introduction to the Theory of Narrative</i> , University of Toronto Press	2017
3.	Rosemarie Garland Thomson, <i>Extraordinary Bodies: Figuring Disability in American Culture and Literature</i> , Columbia University Press	2017
4.	Lennard Davis, <i>The Disability Studies Reader</i> , Routledge	2014
5.	Talia Schaffer, <i>Communities of Care: The Social Ethics of Victorian Fiction</i> , Princeton University Press	2021
6.	Elizabeth Outka, <i>Viral Modernism: The Influenza Epidemic and Interwar Literature</i> , Columbia University Press	2020