COURSE OUTLINE BRIEFS

DEPARTMENT OF EARTH SCIENCE

SARGODHA UNIVERSITY
Pathway to Progress

FACULTY OF SCIENCES

OVERVIEW

Earth Sciences are the fields of study concerned with Earth's physical characteristics, from earthquakes to raindrops, and floods to fossils. The broad aim of the Earth Sciences is to understand the present features and the past evolution of the Earth and to use this knowledge, where appropriate, for the benefit of humankind.

The department offers PhD, MS and BS in geology and MPhil, MSc and BS degree programs in geography. To provide quality education in these disciplines, the department has assembled a well-qualified faculty with strong linkages to national and international institutions.

It has five PhD and eight MPhil qualified faculty members as well as a number of visiting scientists and research associates who strain every nerve to build a vibrant environment for both research and teaching. The department offers education in geology and geography with a wide range of programs including mineralogy, sedimentology, carbonate petrology, sequence stratigraphy, structural geology, tectonics, geophysics, petroleum geology, engineering geology, GIS, remote sensing, hydrology, climate change and air pollution sciences.

Academic Programs Offered

1. BS Geology
2. BS Geography
3. MSc Geography
4. MS Geology
5. MS/M. Phil Geography

BS Geology

Eligibility: At least 45% marks in FSc (Pre-Engineering, Pre-Medical)/ ICS (Math, Physics, Computer Science).
Duration: 04 Year Program (08 Semesters)
Degree Requirements: 136 Credit Hours

Semester-1

Course Code	Course Title	Credit Hours
CHEM-5101	Physical Chemistry	3(3+0)
URCE-5101	Grammar	3(3+0)
GEOL-5101	Introduction to Geology	3(3+0)
URCM-5107	Mathematics I	3(3+0)
PHYS-5101	Mechanics I	3(3+0)
URCI-5105	Islamic Studies	2(2+0)

Semester-2

CHEM-5102	Inorganic Chemistry	3(3+0)
URCE-5102	Language Comprehension & Presentation Skills	3(3+0)
GEOL-5102	Geomorphology	3(3+0)
URCM-5108	Mathematics II	3(3+0)
PHYS-5103	Mechanics II	3(3+0)
GEOL-5103	Geological Fieldwork- I	3(0+3)

Semester-3

URCI-5109	Introduction to information & Communication Technologies	3(3+0)
URCP-5106	Pakistan Studies	2(2+0)
GEOL-5104	Introduction to Paleontology	3(2+1)
GEOL-5105	Stratigraphy	3(2+1)
GEOL-5106	Geostatistics	3(2+1)
GEOL-5107	Mineralogy	3(2+1)

Semester-4

URCE-5103	Academic Writing	3(3+0)
BUSB-5104	Introduction to Management	3(3+0)
GEOL-5108	Petrography	3(2+1)
GEOL-5109	Igneous Petrology	3(2+1)
GEOL-5110	Structural Geology	3(2+1)
GEOL-5111	Geological Fieldwork-II	3(0+3)

Semester-5

GEOL-6112	Geotectonics	3(2+1)
GEOL-6113	Sedimentology	3(2+1)
GEOL-6114	Geophysics	3(2+1)
GEOL-6115	Field Geology	3(3+0)
GEOL-6116	Micropaleontology	3(2+1)
GEOL-6117	Introduction to GIS and RS	3(2+1)

Semester-6

GEOL-6118	Sequence Stratigraphy	3(2+1)
GEOL-6119	Geochemistry	3(2+1)
GEOL-6120	Petroleum Geology	3(2+1)
GEOL-6121	Engineering Geology	3(2+1)
GEOL-6122	Metamorphic Petrology	3(2+1)
GEOL-6123	Geological Fieldwork – III	3(0+3)

Semester-7

GEOL-6124	Geology of Pakistan	3(3+0)
GEOL-6125	Economic Geology	3(2+1)
GEOL-6126	Environmental Geology	3(2+1)
GEOL-6127	Hydrogeology	3(2+1)
*GEOL- 61--	(Elective course)	3(3+0)
*GEOL- 61--	(Elective Course)	3(3+0)

Semester-8

*GEOL- 61--	(Elective Course)	3(3+0)
*GEOL-61--	(Elective Course)	3(3+0)
GEOL-6190	Thesis	6(0+6)

List of Groups and Elective Courses

Groups	Course Code	Course Title	Credit Hour
Group-I Mineralogy and Petrology	GEOL- 6130	Geochemistry II	3(3+0)
	GEOL-6131	Igneous Petrogenesis	3(3+0)
	GEOL- 6132	Metamorphic Petrology-II	3(3+0)
	GEOL-6133	Sedimentary Petrology-II	3(3+0)
	GEOL- 6134	Mineralogy II	3(3+0)
Group-II Engineering Geology	GEOL- 6135	Rock Mechanics	3(3+0)
	GEOL- 6136	Soil Mechanics	3(3+0)
	GEOL- 6137	Seismotectonics	3(3+0)
	GEOL- 6138	Engineering Geology II	3(3+0)
Group-III Petroleum Geosciences	GEOL- 6139	Sequence Stratigraphy II	3(3+0)
	GEOL- 6140	Petroleum Engineering	3(3+0)
	GEOL- 6141	Reservoir Geology	3(3+0)
	GEOL- 6142	Petroleum Geology of Pakistan	3(3+0)
	GEOL- 6143	Organic Geochemistry	3(3+0)
	GEOL-6144	Geological and Geophysical Software Applications	3(3+0)
	GEOL- 6145	Logging and Log Interpretation	3(3+0)
	GEOL- 6146	Seismic Interpretation	3(3+0)
	GEOL- 6147	Basin Modeling	3(3+0)
Group-IV Applied Geophysics	GEOL- 6148	Seismic Stratigraphy	3(3+0)
	GEOL- 6149	Earthquake Seismology	3(3+0)
	GEOL- 6150	Geomagnetism and Paleomagnetism	3(3+0)
	GEOL- 6151	Electrical and Radiometric Exploration Methods	3(3+0)
	GEOL- 6152	Bore-Hole Geophysics	3(3+0)
	GEOL- 6153	Seismic prospecting	3(3+0)
	GEOL- 6154	Gravity and Magnetic Methods	3(3+0)
	GEOL- 6155	Rock Physics	3(3+0)

BS Geography

Eligibility: At least 45% marks in Intermediate or equivalent
Duration: 04 Year Program (08 Semesters)
Degree Requirements: 130 Credit Hours

Semester-1

Course Code	Course Title	Credit Hours
GEOG-5101	Fundamentals of Geography	3(3+0)
URCE-5101	Grammar	3(3+0)
URCI-5105	Islamic Studies	2(2+0)
URCM-5107	Mathematics I	3(3+0)
*GEOL-5101	Introduction to Geology	3(3+0)
*ENVR-5101	Introduction to Environmental Sciences	3(3+0)

Semester-2

GEOG-5102	Physical Geography	3(3+0)
URCE-5102	Language Comprehension &Presentation Skills	3(3+0)
URCP-5106	Pakistan Studies	2(2+0)
*ULAW-5130	Introduction to Basic Laws	3(3+0)
*ENVR-5104	Environmental Geology	3(3+0)
*INTR-5101	Introduction to International Relation	3(3+0)

Semester-3

GEOG-5103	Human Geography	3(3+0)
URCE-5103	Academic Writing	3(3+0)
GEOG-5104	Map Work	3(2+1)
URCS-5108	Introduction to Statistics	3(3+0)
*SOCIO-5101	General Sociology I	3(3+0)
URCI-5109	Introduction to Information& Communication Technologies	3(3+0)

Semester-4

GEOG-5105	History and Development of Geographic Thought	3(3+0)
GEOG-5106	Surveying	3(1+2)
URCE-5104	Introduction to English Literature	3(3+0)
*PSYC-5101	Introduction to Psychology	3(3+0)
*ECON-5112	Introduction to Economics	3(3+0)

*as notified by the Chairman from list A

Semester-5

GEOG-6107	Regional Concepts	3(3+0)
GEOG-6108	Geomorphology	3(3+0)
GEOG-6109	Climatology	3(3+0)
GEOG-6110	Economic Geography	3(3+0)
GEOG-6111	Quantitative MethodsIn Geography	3(3+0)
GEOG-6112	Principles of Cartography	3(1+2)

Semester-6

GEOG-6113	Oceanography	3(3+0)
GEOG-6114	Remote Sensing	3(2+1)
GEOG-6115	Research Methods	3(3+0)
GEOG-6116	Population Geography	3(3+0)
GEOG-6117	Geographical Information System	3(2+1)

Semester-7

GEOG-6118	Environmental Geography	3(3+0)
GEOG-6119	Urban Geography	3(3+0)
GEOG- 6120	Digital Image Processing	3(2+1)
***GEOG--61--	Regional Geography	3(3+0)
**GEOG-61--	Elective Course	3(3+0)

Semester-8

GEOG-6121	Geography of Pakistan	3(3+0)
**GEOG-61--	Elective course	3(3+0)
**GEOG-61---	Elective Course	3(3+0)
****GEOG-61--	Field Survey	6(0+6)
GEOG-6190	Thesis (in lieu of two elective papers)	6(0+6)

**as notified by the Chairman from list B.
***as notified by the Chairman from list C.
****as notified by the Chairman from list D.

List A: Elective Papers:-

Course code	Course Tile	Credit Hors
GEOL-5101	Introduction to Geology	3(3+0)
ENVR-5101	Introduction to Environmental Sciences	3(3+0)
ENVR-5104	Environmental Geology	3(3+0)
CHEM-5101	Physical Chemistry	3(3+0)
CHEM-5102	Inorganic Chemistry	3(3+0)
ECON-5112	Introduction to Economics	3(3+0)
PHYS-5101	Mechanics	3(3+0)
PSYC-5101	Introduction to Psychology	3(3+0)
SOCI-5101	General Sociology I	3(3+0)
ULAW-5130	Introduction to Basic Law	3(3+0)
INTR-5101	Introduction to international Relation	3(3+0)
POLS-5101	Introduction to Political Science	3(3+0)

List B: Elective Courses

Course code	Course Tile	Credit Hours
GEOG-6122	Cultural Geography	3(3+0)
GEOG -6123	Natural Hazards & Disaster Management	3(3+0)
GEOG-6124	Geography of Manufacturing	3(3+0)
GEOG-6125	Hydro Geography	3(3+0)

GEOG-6126	Medical Geography	3(3+0)
GEOG-6127	Political Geography	3(3+0)
GEOG-6128	Regional Planning & Development	3(3+0)
GEOG-6129	Settlement Geography	3(3+0)
GEOG-6130	Tourism Geography	3(3+0)
GEOG-6131	Transportation Geography	3(3+0)
GEOG-6132	Soil Geography	3(3+0)
GEOG-6133	Meteorology	3(3+0)
GEOG -6134	Climate Change Studies	3(3+0)
GEOG- 6135	Social Geography	3(3+0)
GEOG-6136	Geography of Migration and Regional Development	3(3+0)
GEOG-6137	Behavioural Geography	3(3+0)
GEOG- 6138	Historical Geography	3(3+0)
GEOG-6139	Geography of Religions	3(3+0)
GEOG-6140	Geography of Crimes	3(3+0)
GEOG-6141	Gender Geography	3(3+0)
GEOG-6142	Geography of Marketing	3(3+0)
GEOG-6143	Industrial Geography	3(3+0)
GEOG-6144	Urban and rural land use Studies	3(3+0)
GEOG-6145	Regional Planning and Development	3(3+0)
GEOG- 6146	Geography of Housing	3(3+0)
GEOG-6147	Geography of Health Care	3(3+0)
GEOG-6148	Geography of Nutrition	3(3+0)
GEOG-6149	Military Geography	3(3+0)
GEOG-6150	Geography of Administration	3(3+0)
GEOG -6151	Geo-Archaeology	3(3+0)
GEOG-6152	Geography of prehistoric cultures & Civilizations	3(3+0)
GEOG-6153	Environmental perceptions in Geography	3(3+0)
GEOG-6154	Quantitative Geography	3(3+0)
GEOG-6155	Geography of Natural Hazards and Disasters	3(3+0)
GEOG-6156	Applied Geomorphology	3(3+0)
GEOG-6157	Development Planning	3(3+0)
GEOG-6158	Sustainable Development of Natural Resource	3(3+0)
GEOG-6158	Environmental Impact Assessment (EIA)	3(3+0)
GEOG-6159	Applied Cartography	3(3+0)
GEOG-6160	Social Impact Assessment (SIA)	3(3+0)
GEOG-6161	Mountain Geography	3(3+0)
GEOG-6162	Geography of Retailing	3(3+0)
GEOG-6163	Urban Environmental Planning &Management	3(3+0)
GEOG-6164	Geography of Wetlands	3(3+0)
GEOG-6165	Urban Planning	3(3+0)
GEOG-6166	Urban and Landscape Ecology	3(3+0)
GEOG-6167	Agricultural Geography	3(3+0)
GEOG-6168	Conservation of Resources	3(3+0)

List C: Regional Geography

Course Code	Course Tile	Credit Hours
GEOG-6170	South Asia	3(3+0)
GEOG-6171	Australia	3(3+0)
GEOG-6172	Central Asia	3(3+0)
GEOG-6173	Eastern Asia China, Japan & Korea	3(3+0)
GEOG-6174	Europe	3(3+0)
GEOG-6175	Geography of the Muslim World	3(3+0)
GEOG-6176	North America	3(3+0)
GEOG-6177	S. West Asia	3(3+0)
GEOG-6178	South Ameri	3(3+0)
GEOG-6179	South East Asia	3(3+0)

List D. Field Survey Report

The students shall carry out field survey on any one of the following fields:

Course Code	Course Tile	Credit Hours
GEOG-6181	Demographic Survey	6(0+6)
GEOG-6182	Hydrological Survey	6(0+6)
GEOG-6183	Industrial Survey	6(0+6)
GEOG-6184	Land Use Survey	6(0+6)
GEOG-6185	Landforms Survey	6(0+6)
GEOG-6186	Soil Survey	6(0+6)
GEOG-6187	Urban Survey	6(0+6)

Each student shall be required to collect data/information pertaining to his/her topic in a selected area/region, tabulate the data and write report on it.

GEOG-6190: Thesis
(In lieu of two optional papers in semester VIII)

MSc Geography

Eligibility: At least 45% marks in graduation with Geography as elective subject
Duration: 02 Year Program (04 Semesters)
Degree Requirements: 66 Credit Hours

Semester-1

Course Code	Course Title	Credit Hours
GEOG-6201	Geographic Thought (Ancient)	3(3+0)
GEOG-6202	Economic Geography	3(3+0)
GEOG-6203	Geomorphology-I	3(3+0)
GEOG-6204	Climatology	3(3+0)
GEOG-6205	Quantitative Methods	3(3+0)
GEOG-6206	Principles of Cartography	1(1+0)
GEOG-6207	Lab. Work	2(0+2)

Semester-2

GEOG-6208	Geographic Thought (Modern)	3(3+0)
GEOG-6209	Commercial Geography	3(3+0)
GEOG-6210	Geomorphology-II	3(3+0)
GEOG-6211	Oceanography	3(3+0)
GEOG-6212	Research Methods	3(3+0)
GEOG-6213	Surveying	3(1+2)

Semester-3

GEOG-6214	Population Geography	3(3+0)
GEOG- 6215	Remote Sensing	3(2+1)
GEOG- 6216	Geographical Information System	3(2+1)
*GEOG. 62--	Elective	3(3+0)
**GEOG- 62--	Regional Geography	3(3+0)

Semester-4

GEOG-6217	Pakistan: (Environment & Economy)	3(3+0)
*GEOG- 62--	Elective	3(3+0)
*GEOG- 62--	Elective	3(3+0)
***GEOG-62-	Field Survey	6(0+6)
GEOG-6290	Thesis (in lieu of two elective)	6(0+6)

*As notified by chairman from the attached list A, depending upon available resources
** As notified by chairman from the attached list B, depending upon available resources
***As notified by chairman from the attached list C, depending upon available resources

List: A

Course Code	Course Title	Credit Hours
GEOG-6221	Urban Geography & Planning	3(3+0)
GEOG-6222	Political Geography	3(3+0)
GEOG-6223	Conservation of Resources	3(3+0)

GEOG-6224	Hydro Geography	3(3+0)
GEOG-6225	Rural Settlement Geography	3(3+0)
GEOG-6226	Cultural Geography	3(3+0)
GEOG-6227	Transportation Geography	3(3+0)
GEOG-6218	Environmental Geography	3(3+0)
GEOG-6229	Regional Planning & Development	3(3+0)
GEOG-6230	Natural Hazards & Disaster Management	3(3+0)
GEOG-6231	Industrial Geography	3(3+0)
GEOG-6232	Agricultural Geography	3(3+0)
GEOG-6233	Geography of Manufacturing	3(3+0)
GEOG-6234	Tourism Geography	3(3+0)
GEOG-6235	Medical Geography	3(3+0)
GEOG-6236	Geography of Community Health	3(3+0)

List: B

Course Code	**Course Title**	Credit Hours
GEOG-6237	Eastern Asia China, Japan & Korea	3(3+0)
GEOG-6238	S. West Asia	3(3+0)
GEOG-6239	South East Asia	3(3+0)
GEOG-6240	South Asia	3(3+0)
GEOG-6241	Europe	3(3+0)
GEOG-6242	Central Asia	3(3+0)
GEOG-6243	North America	3(3+0)
GEOG-6244	Australia	3(3+0)
GEOG-6245	South America	3(3+0)
GEOG-6246	Geography of the Muslim World	3(3+0)

List: C

The students will have to carry out field survey on any one of the following topics:

Course Code	**Course Title**	Credit Hours
GEOG-6247	Demographic survey	6(0+6)
GEOG-6248	Urban Survey	6(0+6)
GEOG-6249	Industrial survey	6(0+6)
GEOG-6250	Transportation survey	6(0+6)
GEOG-6251	Land Use survey	6(0+6)
GEOG-6252	Landforms survey	6(0+6)
GEOG-6253	Soil survey	6(0+6)
GEOG-6254	Hydrological survey	6(0+6)
GEOG-6255	Geo Hazards Survey	6(0+6)
GEOG-6256	EIA (Environmental Impact Assessment)	6(0+6)

Each student shall be required to collect data/information pertaining to his/her topic in a selected area/region, tabulate the data and write report on it.

GEOG-6290 Thesis (In lieu of two optional papers)

MS Geology

Eligibility: MSc/ BS Geology or equivalent with 2nddivision or CGPA 2.00 out of 4.00 + Departmental Entry Test (at least 50% marks
Duration: 02 Year Program (04 Semesters)
Degree Requirements: 30 Credit Hours

Semester 1 and 2

Course No	Elective/Specialized Courses	Credit Hours
Four elective papers each with 3 credit hours from list A for 1st semester, and four elective papers eachwith3credithoursfrom list B will be selected for course work. Numberofoptionsthatshallbeofferedduringthecourseofstudywilldependupontheavailabilityof faculty and lab facilities.		24

Semester 3 and 4

Course	Credit Hours
MS Thesis Writing and its evaluation as per University of Sargodha Rules in 3rd and 4th Semesters.	6

List A:
Four courses out of the following subjects are suggested for the MS Geology course work in 1st Semester.

Course Code	Course Title	Credit Hours
GEOL-7101	Applied Mineralogy	3(3+0)
GEOL-7102	Metamorphic Petrology	3(3+0)
GEOL-7103	Clastic Sedimentology	3(3+0)
GEOL-7104	Tectonics	3(3+0)
GEOL-7105	Micropaleontology	3(3+0)
GEOL-7106	Structural Geology	3(3+0)
GEOL-7107	Seismology	3(3+0)
GEOL-7108	Hydrogeology	3(3+0)
GEOL-7109	Soil Mechanics	3(3+0)
GEOL-7110	Metallic Mineral Deposits	3(3+0)
GEOL-7111	Ore Geology, Mining and Processing	3(3+0)
GEOL-7112	Isotope Geology and Geochronology	3(3+0)
GEOL-7113	Geology of Pakistan	3(3+0)
GEOL-7114	Sedimentary Basins	3(3+0)
GEOL-7115	Remote Sensing & GIS	3(3+0)
GEOL-7116	Environmental Geology	3(3+0)
GEOL-7117	Geohazard Investigation	3(3+0)
GEOL-7118	Geotechnical Engineering	3(3+0)
GEOL-7119	Vertebrate Paleontology	3(3+0)
GEOL-7120	Metallogeny and Plate Tectonics	3(3+0)
GEOL-7121	Reservoir Geognosy	3(3+0)
GEOL-7122	Earthquake Seismology	3(3+0)
GEOL-7123	Thermodynamics	3(3+0)
GEOL-7124	Basin Analysis	3(3+0)
GEOL-7125	Groundwater Investigation	3(3+0)
GEOL-7126	Industrial Mineralogy	3(3+0)
GEOL-7127	Hydrological systems and Environment	3(3+0)
GEOL-7128	Applied Structure Technique	3(3+0)
GEOL-7129	Metamorphic Structure	3(3+0)

GEOL-7130	Sedimentary Petrology	3(3+0)

List B:

Four courses out of the following subjects are suggested for the MS Geology course work in 2nd Semester.

Course Code	Course Title	Credit Hours
GEOL-7131	Igneous Petrology	3(3+0)
GEOL-7132	Applied Geochemistry	3(3+0)
GEOL-7133	Carbonate Sedimentology	3(3+0)
GEOL-7134	Paleontology	3(3+0)
GEOL-7135	Marine Geology	3(3+0)
GEOL-7136	Applied Geophysics	3(3+0)
GEOL-7137	Paleomagnetism	3(3+0)
GEOL-7138	Engineering Geology	3(3+0)
GEOL-7139	Rock Mechanics	3(3+0)
GEOL-7140	Non Metallic Mineral Deposits	3(3+0)
GEOL-7141	Advanced Instrumentation	3(3+0)
GEOL-7142	Coal Geology	3(3+0)
GEOL-7143	Stratigraphy of Pakistan	3(3+0)
GEOL-7144	Petroleum Geology	3(3+0)
GEOL-7145	Engineering Seismology	3(3+0)
GEOL-7146	Applied Hydrogeology	3(3+0)
GEOL-7147	Field Geology	3(3+0)
GEOL-7148	Invertebrate Paleontology	3(3+0)
GEOL-7149	Palynology and Paleobotany	3(3+0)
GEOL-7150	Sequence Stratigrathy	3(3+0)
GEOL-7151	Petroleum Geology of Pakistan	3(3+0)
GEOL-7152	Bore-hole Geophysics	3(3+0)
GEOL-7153	Isotope Geochemistry	3(3+0)
GEOL-7154	Quaternary Geology	3(3+0)
GEOL-7155	Groundwater Engineering	3(3+0)
GEOL-7156	Environmental Hazards	3(3+0)
GEOL-7157	Environmental Impact Assessment and Management	3(3+0)
GEOL-7158	Tectonic of Pakistan	3(3+0)
GEOL-7159	Neotectonic	3(3+0)
GEOL-7160	Clay Mineralogy	3(3+0)

MS/ M.Phil. Geography

Eligibility: MSc/ BS Geography or equivalent with 2nd division or CGPA 2.00 out of 4.00 + Departmental Entry Test (at least 50% marks)
Duration: 02 Year Program (04 Semesters)
Degree Requirements: 30 Credit Hours

Semester-1

Course Code	Course Title	Credit Hours
GEOG-7101	Advanced Research Methods	3(3+0)
GEOG-7102	Techniques in Geo-Informatics	3(3+0)
GEOG-7103	Advanced Quantitative Techniques	3(3+0)
*GEOG-71--	Elective Course	3(3+0)

* As notified by chairman from the attached list depending upon available resources

Semester – 2

Course No	Elective/Specialized Courses	Credit Hours
Four elective papers, each with 3 credit hours to be selected in second semester from given list. Number of options that shall be offered during the course of study shall depend upon the availability of faculty and lab facilities		4*3=12

Semester - 3 and 4

Course	Credit Hours
MS/M.Phil. Thesis Writing and its evaluation as per University of Sargodha Rules in3rd and 4th Semesters.	**6**

List of Courses for MS/M. Phil. Geography
Compulsory Courses

Course Code	Course Title	Credit Hours
GEOG-7101	Advanced Research Methods	3(3+0)
GEOG-7102	Techniques in Geo-informatics	3(3+0)
GEOG-7103	Advanced Quantitative Techniques	3(3+0)

Elective Courses

GEOG-7106	Digital Cartography	3(3+0)
GEOG-7107	Environmental Geography	3(3+0)
GEOG-7108	Hydro Geography	3(3+0)
GEOG-7109	Cultural Geography	3(3+0)
GEOG-7110	Geography of Natural Hazards and Disasters	3(3+0)
GEOG-7111	Industrial Geography	3(3+0)
GEOG-7112	Medical Geography	3(3+0)
GEOG-7113	Political Geography	3(3+0)
GEOG-7114	Population Geography	3(3+0)
GEOG-7115	Regional Planning & Development	3(3+0)
GEOG-7116	Urban Geography	3(3+0)
GEOG-7117	Digital Image Processing	3(3+0)
GEOG-7118	Advanced techniques in GIS	3(3+0)
GEOG-7119	Principles of Remote Sensing	3(3+0)
GEOG-7120	Transportation Geography	3(3+0)
GEOG-7121	Agricultural Geography	3(3+0)
GEOG-7122	Urban Ecology	3(3+0)
GEOG-7123	Geography of Recreation and Tourism	3(3+0)
GEOG-7124	Meteorology	3(3+0)
GEOG-7125	Pleistocene Geomorphology	3(3+0)
GEOG-7126	Soil Geography	3(3+0)

BS
GEOLOGY

GEOL - 5101 Introduction to Geology 3(3+0)

This course is designed to acquire the knowledge about the basic concepts of geology. This will help the students to get knowledge about various types of rocks, minerals and the processes of their formation. Geology is the core discipline of the earth sciences and encompasses many different phenomena, including plate tectonics and mountain building, volcanoes and earthquakes, and the long-term evolution of Earth's atmosphere, surface and life. The goal of the Geology undergraduate program is to equip students with the fundamental knowledge of the diverse fields of Geology (encompassing Geomorphology & Surface Processes, Hydrology & Low-Temperature Geochemistry, Sedimentology & Paleoecology, and Tectonics and Solid-Earth Processes). In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. It helps to know the geologic time scale and place important geologic events in a temporal framework.

Contents

1. Introduction and scope of geology; importance and relationship with other sciences;
2. History and philosophy of geology; Earth as a member of the solar system;
3. Earth's origin, age, composition and internal structure;
4. Introduction to plate tectonics, Isostasy; mountain building processes;
5. Earthquakes and volcanoes; weathering and erosion;
6. Introduction, identification and classification of rocks and minerals;
7. Sedimentary, igneous and metamorphic structures;
8. Introduction to fossils in sedimentary rocks;
9. Introduction to folds, faults, joints, cleavage, foliation, lineation and unconformities;
10. Geological Time Scale; Law of Superposition, present is key to the past and Law of Faunal Succession;
11. Concept and techniques of geological dating, relative and absolute dating; evolution of life on earth;
12. Use of Brunton Compass and GPS, etc.

Recommended Texts

1. Plummer, C. C., Carlson, D. H., & Hammersley, L. (2016). *Physical geology*. New York: McGraw-Hill.
2. Plummer, C. C., McGeary, D., & Carlson, D. H. (2000). *Physical Geology: Earth Revealed*. New York: McGraw-Hill.

Suggested Readings

1. McGeary, D., Carlson, D. H., & Plummer, C. C. (2011). *Physical geology*. New York: McGraw-Hill.
2. Smith, G., & Pun, A. (2013). *How Does Earth Work? Physical Geology and the Process of Science: Pearson New International Edition.* London: Pearson Higher Education.
3. McClay, K. R. (1999). *The mapping of geological structures*. Hoboken: John Wiley & Sons.

URCE-5101 **Grammar** **3(3+0)**

The course introduces the students to the underlying rules to acquire and use language in academic context. The course aims at developing grammatical competence of the learners to use grammatical structures in context in order to make the experience of learning English more meaningful enabling the students to meet their real life communication needs. The objectives of the course are to, reinforce the basics of grammar, understand the basic meaningful units of language, and introduce the functional aspects of grammatical categories and to comprehend language use by practically working on the grammatical aspects of language in academic settings. After studying the course, students would be able to use the language efficiently in academic and real life situations and integrate the basic language skills in speaking and writing. The students would be able to work in a competitive environment at higher education level to cater with the long term learners' needs.

Contents

1. Parts of speech
2. Noun and its types
3. Pronoun and its types
4. Adjective and its types
5. Verb and its types
6. Adverb and its types
7. Prepositions and its types
8. Conjunction and its types
9. Phrases and its different types
10. Clauses and its different types
11. Sentence, parts of sentence and types of sentence
12. Synthesis of sentence, Conditional sentences, Voices
13. Narration
14. Punctuation
15. Common grammatical errors and their corrections

Recommended Texts

1. Eastwood, J. (2011). *A basic English grammar*. Oxford: Oxford University Press.
2. Swan, M. (2018). *Practical English usage* (8th ed.). Oxford: Oxford University Press.

Suggested Readings

1. Thomson, A. J., & Martinet, A. V. (1986). *A practical English grammar*. Oxford: Oxford University Press.
2. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.
3. Hunston, S., & Francis, G. (2000). *Pattern grammar: A corpus-driven approach to the lexical grammar of English*. Amsterdam: John Benjamins.

URCM – 5107 Mathematics I 3(3+0)

The goal of Mathematics I is to prepare students for first-year Calculus. Helping students gain proficiency in their understanding and ability to utilize real-valued functions, the primary tool in Calculus, accomplishes this goal. Students are presented a broad set of 'function tools', including a general understanding of function properties together with a 'library' of commonly used functions. It is intended that students become skilled at recognizing the different families of functions and the primary properties that set each apart, are able to apply the general function properties to each type of function, and are able to use the special set of algebraic skills associated with each. Students are also expected to become adept in utilizing and interpreting the results from graphing calculators, as an important investigative tool.

Contents

1. Preliminaries
2. Real-number system, complex numbers
3. Introduction to sets, set operations, functions, types of functions.
4. Matrices Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.
5. Quadratic Equations
6. Solution of quadratic equations, qualitative analysis of roots of a quadratice
7. Equations reducible to quadratic equations
8. Cube roots of unity, relation between roots and coefficients of quadratic
9. Sequences and Series
10. Arithmetic progression
11. Geometric progression
12. Harmonic progression
13. Binomial Theorem
14. Introduction to mathematical induction
15. Binomial theorem with rational and irrational indices.
16. Trigonometry, Fundamentals of trigonometry, Trigonometric identities.

Recommended Texts

1. Thomas, G. B., & Finney, A. R. *(2005). Calculus.* Reading: Addison-Wesley.
2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley.

Suggested Readings

1. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole.
2. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company.
3. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.). Reading: Addison-Wesley.

URCI-5105 Islamic Studies 2(2+0)

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'an and Sunnah.. Islamic Studies is the academic study of Islam and Islamic culture. It majorly comprises of the importance of life and that after death. It is one of the best systems of education, which makes an ethical groomed person with the qualities which he/she should have as a human being. The basic sources of the Islamic Studies are the Holy Qur'an and Sunnah or Hadith of the Holy Prophet Muhammadﷺ. The learning of the Qur'an and Sunnah guides the Muslims to live peacefully.

Contents

1. Study of the Qur'an (Introduction to the Qur'an, Selected verses from *Surah Al-Baqarah, Al-Furqan, Al-Ahzab, Al-Mu'minoon, Al-An'am, Al-Hujurat, Al-Saff*)
2. Study of the Hadith (Introduction to Hadith literature, Selected Ahadith (Text and Translation)
3. Introduction to Qur'anic Studies
4. Basic Concepts of Qur'an
5. History of Quran
6. Basic Concepts of Hadith
7. History of Hadith
8. Kinds of Hadith
9. Uloom –ul-Hadith
10. Sunnah & Hadith
11. Seerat ul-Nabi (PBUH), necessity and importance of Seerat, role of Seerah in the development of personality, Pact of Madinah, Khutbah Hajjat al-Wada' and ethical teachings of Prophet (PBUH).
12. Legal Position of Sunnah

Recommend Texts

1. Hassan, A. (1990). *Principles of Islamic jurisprudence*. New Dehli: Adam Publishers.
2. Zia-ul-Haq, M. (2001). *Introduction to al-Sharia al-Islamia*. Lahore: Aziz Publication.

Suggested Readings

1. Hameedullah, M. (1957). *Introduction to Islam*. Lahore: Sh M Ashraf Publisher.
2. Hameedullah, M. (1980). *Emergence of Islam*. New Dehli: Adam Publishers.
3. Hameedullah, M. (1942). *Muslim conduct of state*. Lahore: Sh M Ashraf Publisher.

GEOL - 5102 **Geomorphology** **3(3+0)**

This course is designed to acquire the knowledge about the formation of various landforms on the surface of the earth. This will help the students to understand the processes by which the various types of structures developed on the earth surface due to erosional and depositional processes. In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. It helps to know the geologic time scale and place important geologic events in a temporal framework. Identify and interpret common fossils, common rock-forming minerals and rock-forming processes, Interpret environments of deposition of sedimentary rocks, Identify common rocks and interpret them with respect to tectonics.

Contents

1. Geomorphological processes
2. Weathering and erosion
3. Glaciers and their erosional and depositional landforms
4. Geological work of wind and associated features
5. Erosional and depositional work of surface and subsurface water
6. Valley and base-level development and its types
7. Drainage pattern, stream and erring and development of flood plains
8. The erosional and depositional work of sea
9. Development of coastal landform: Geomorphic cycles and associated landforms produced by tectonics and volcanic activity
10. Introduction to tectonic geomorphology
11. Introduction to topographic maps
12. Aerial photographs and satellite imageries

Lab. Work

1. Identification of geomorphic features by using topographic maps,
2. Relief maps and interpretation of 3D relief diagrams on computer.

Recommended Texts

1. Summerfield, M. A. (2014). *Global geomorphology*. Vale of White Horse: Routledge.
2. Bierman, P. R., Montgomery, D. R., & Massey, C. A. (2013). *Key Concepts in Geomorphology*-NSF supports community-based creation of a new style of textbook. In AGU Fall Meeting Abstracts.

Suggested Readings

1. Adrian, A. (2012). *Introducing geomorphology: a guide to landforms and processes*. London: Routledge.

2. Gregory, K. J., & Lewin, J. (2014). *The basics of geomorphology: key concepts*. London: Routledge.
3. Moses, A. (2013). *Geomorphology*. London: Routledge.

URCE-5102 Language Comprehension & Presentation Skills 3(3+0)

The course aims at developing linguistic competence by focusing on basic language skills in integration to make the use of language in context. It also aims at developing students' skills in reading and reading comprehension of written texts in various contexts. The course also provides assistance in developing students' vocabulary building skills as well as their critical thinking skills. The contents of the course are designed on the basis of these language skills: listening skills, pronunciation skills, comprehension skills and presentation skills. The students require a grasp of English language to comprehend texts as organic whole, to interact with reasonable ease in structured situations, and to comprehend and construct academic discourse. The course objectives are to enhance students' language skill management capacity, to comprehend text(s) in context, to respond to language in context, and to write structured response(s).

Contents

1. Listening skills, Listening to isolated sentences and speech extracts
2. Managing listening and overcoming barriers to listening
3. Expressing opinions (debating current events) and oral synthesis of thoughts and ideas
4. Pronunciation skills,
5. Recognizing phonemes, phonemic symbols and syllables, pronouncing words correctly
6. Understanding and practicing stress patterns and intonation patterns in simple sentences
7. Comprehension skills
8. Reading strategies, summarizing, sequencing, inferencing, comparing and contrasting
9. Drawing conclusions, self-questioning, problem-solving, relating background knowledge
10. Distinguishing between fact and opinion, finding the main idea, and supporting details
11. Text organizational patterns, investigating implied ideas, purpose and tone of the text
12. Critical reading, SQ3R method
13. Presentation skills, features of good presentations, different types of presentations
14. Different patterns of introducing a presentation, organizing arguments in a presentation
15. Tactics of maintaining interest of the audience, dealing with the questions of audience
16. Concluding a presentation, giving suggestions and recommendations

Recommended Texts

1. Mikulecky, B. S., & Jeffries, L. (2007). *Advanced reading power: Extensive reading, vocabulary building, comprehension skills, reading faster*. New York: Pearson.
2. Helgesen, M., & Brown, S. (2004). *Active listening: Building skills for understanding*. Cambridge: Cambridge University Press.

Suggested Readings

1. Roach, C. A., & Wyatt, N. (1988). *Successful listening*. New York: Harper & Row.

2. Horowitz, R., & Samuels, S. J. (1987). *Comprehending oral and written language*. San Diego: Academic Press.

URCM – 5108 Mathematics II 3(3+0)

Calculus is the mathematical study of continuous change. It has two major branches, differential calculus and integral calculus. Both branches make use of the fundamental notions of convergence of infinite sequences and infinite series to a well-defined limit. Modern calculus is considered to have been developed in 17th century .A course in calculus is a gateway to other, more advanced courses in mathematics devoted to the study of functions and limits, broadly called mathematical analysis. Calculus is used in every branch of the physical sciences, actuarial science, computer science, medicine, demography, and in other fields. It allows one to go from rates of change to the total change or vice versa, and many times in studying a problem we know one and are trying to find the other. This course aims to provide students with the essential concepts of mathematics and how these can be employed for analyzing real data.

Contents

1. Preliminaries
2. Real-number line
3. Functions and their graphs
4. Solution of equations involving absolute values, inequalities.
5. Limits and Continuity
6. Limit of a function
7. Left-hand and right-hand limits
8. Continuity
9. Continuous functions.
10. Derivatives and their Applications
11. Differentiable functions
12. Differentiation of polynomial
13. Rational and transcendental functions, derivatives.
14. Integration and Definite Integrals
15. Techniques of evaluating indefinite integrals
16. Integration by substitution, integration by parts
17. Change of variables in indefinite integrals.

Recommended Texts

1. Thomas, G. B., & Finney, A. R. *(2005). Calculus.* Reading: Addison-Wesley.
2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley.

Suggested Readings

1. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole.
2. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company.
3. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.), Reading: Addison-Wesley.

GEOL - 5103 Geological Fieldwork-I 3(0+3)

This course is designed to identify various types of rocks, field stratigraphy, fossils, structural features and landforms in the field. This will help the students to understand various types of criteria to recognize rocks and other geological features in the field. The course emphasizes the basic skills essential to identify rocks according to different aspects, correlation & features also to locate yourself in the field and make essential field observations and measurements. The geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future. As geology is the subject of field and to explore the earth which is not possible without fieldwork. During the first two years, students will perform about two weeks of fieldwork. It will lead to becoming familiar with major rocks and basic geological mapping techniques. Each field trip will be followed by report writing and Viva Voce / Evaluation.

Contents

1. Field based exercises
2. Identification different rock types.
3. Identification of different geological features
4. Identification of different geomorphic features
5. Identify different mass wasting phenomenon in field
6. Basic concept of relief and elevation
7. Essential field observations and measurements
8. Utilization of different types of maps in field
9. Topographic maps
10. Basic geological mapping techniques
11. Each field trip will be followed by report writing and Viva Voce / Evaluation.

Recommended Texts

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field.* New York: Wiley.

URCI-5109 Introduction to Information & Communication Technologies 3 (3+0)

The course introduces students to information and communication technologies and their current applications in their respective areas. Objectives include basic understanding of computer software, hardware, and associated technologies. They can make use of technology to get maximum benefit related to their study domain. Students can learn how the Information and Communications systems can improve their work ability and productivity. How Internet technologies, E-Commerce applications and Mobile Computing can influence the businesses and workplace. At the end of semester students will get basic understanding of Computer Systems, Storage Devices, Operating systems, E-commerce , Data Networks, Databases, and associated technologies. They will also learn Microsoft Office tools that includes Word, Power Point, Excel. They will also learn Open office being used on other operating systems and platforms. Specific software's related to specialization areas are also part of course.. Course will also cover Computer Ethics and related Social media norms and cyber laws.

Contents

1. Introduction, Overview and its types.
2. Hardware: Computer Systems & Components, Storage Devices and Cloud Computing.
3. Software: Operating Systems, Programming and Application Software,
4. Introduction to Programming Language
5. Databases and Information Systems Networks
6. The Hierarchy of Data and Maintaining Data,
7. File Processing Versus Database Management Systems
8. Data Communication and Networks.
9. Physical Transmission Media & Wireless Transmission Media
10. Applications of smart phone and usage
11. The Internet, Browsers and Search Engines.
12. Websites Concepts, Mobile Computing and their applications.
13. Collaborative Computing and Social Networking
14. E-Commerce & Applications.
15. IT Security and other issues
16. Cyber Laws and Ethics of using Social media

Recommended Texts

1. Vermaat, M. E. (2018). *Discovering computers: digital technology, data and devices.* Boston: Course Technology Press.

Suggested Readings

1. Timothy J. O'Leary & Linda I. (2017). *Computing essentials* (26th ed.). San Francisco: McGraw Hill.
2. Schneider, G. M., & Gersting, J. (2018). *Invitation to computer science*. Boston: Cengage Learning.

URCP-5106 Pakistan Studies 2(2+0)

The course is designed to acquaint the students of BS Programs with the rationale of the creation of Pakistan. The students would be apprised of the emergence, growth and development of Muslim nationalism in South Asia and the struggle for freedom, which eventually led to the establishment of Pakistan. While highlighting the main objectives of national life, the course explains further the socio-economic, political and cultural aspects of Pakistan's endeavours to develop and progress in the contemporary world. For this purpose, the foreign policy objectives and Pakistan's foreign relations with neighbouring and other countries are also included. This curriculum has been developed to help students analyse the socio-political problems of Pakistan while highlighting various phases of its history before and after the partition and to develop a vision in them to become knowledgeable citizens of their homeland.

Contents

1. Contextualizing Pakistan Studies
2. Geography of Pakistan: Geo-Strategic Importance of Pakistan
3. Freedom Movement (1857-1947)
4. Pakistan Movement (1940-47)
5. Muslim Nationalism in South Asia
6. Two Nations Theory
7. Ideology of Pakistan
8. Initial Problems of Pakistan
9. Political and Constitutional Developments in Pakistan
10. Economy of Pakistan: Problems and Prospects
11. Society and Culture of Pakistan
12. Foreign Policy Objectives of Pakistan and Diplomatic Relations
13. Current and Contemporary Issues of Pakistan
14. Human Rights: Issues of Human Rights in Pakistan

Recommended Texts

1. Kazimi, M. R. (2007). *Pakistan studies.* Karachi: Oxford University Press.
2. Sheikh, J. A. (2004). *Pakistan's political economic and diplomatic dynamics.* Lahore: Kitabistan Paper Products.

Suggested Readings

1. Hayat, S. (2016). *Aspects of Pakistan movement.* Islamabad: National Institute of Historical and Cultural Research.
2. Kazimi, M. R (2009). *A concise history of Pakistan.* Karachi: Oxford University Press.
3. Talbot, Ian (1998). *Pakistan: A modern history*. London: Hurst and Company.

GEOL - 5104 Introduction to Paleontology 3(2+1)

This course is designed to acquire the knowledge about the various types of fossils and their significance. This will help the students to understand various morphological features of fossils; their classification, identification and distribution in geologic time.This course will provide interested students with a better understanding of one of the most valuable tools in stratigraphic and paleo environmental analyses, fossils. The course will introduce the major marine and non-marine invertebrate taxonomic groups found in the fossil record and what we know about them – their stratigraphic range, modes of life, and environmental preferences. This course is designed to acquire the knowledge about the various types of fossils and their significance. This will help the students to understand various morphological features of fossils; their classification, identification and distribution in geologic time. The main objectives of this subject are to identify the major fossil invertebrate groups and their stratigraphic and paleo environmental significance, to apply the techniques used in the processing of samples for paleontological analyses. to apply fossil data analyses and statistical applications used for biostratigraphic and paleo environmental interpretation, to use paleontological data to solve biostratigraphic, paleo environmental, paleo ecological, environmental, and ecological problems.

Contents

1. Introduction to fossils and their significance;
2. Modes of fossilization,
3. Study of morphology, range and broad classification of major invertebrate phyla i .e Coelenterata, Brachiopoda, Mollusca, Arthropoda (trilobite) and Echinodermata (echinoidea);
4. Introduction to micro fossils;
5. Introduction to paleobotany;
6. Introduction and classification of major vertebrates i.e. mammals, amphibians, reptiles and picies;
7. Introduction to Micropaleontology i.e. Foraminifera, Briozone, Ostrocodes and Conodonts etc.
8. Index fossils;
9. Introduction to major invertebrate and microfossils of Pakistan.

Recommended Texts

1. Moore, R. C., Lalicker, C. G., Lalicker, C. G., & Fischer, A. G. (2000). *Invertebrate fossils*. New York: McGraw-Hill.
2. Woods, H. (1926). *Palaeontology, invertebrate*. Cambridge: CUP Archives.

Suggested Readings

1. Raup, D. M., Raup, D., & Stanley, S. M. (1978). *Principles of paleontology*. New York: Macmillan.
2. Clarkson, E. N. K. (2009). *Invertebrate palaeontology and evolution*. Hoboken: John Wiley & Sons.
3. Levinton, J. S., & Levinton, J. S. (2000). *Genetics, paleontology, and macroevolution.* Cambridge: Cambridge University Press.

GEOL - 5105 Stratigraphy 3(2+1)

This course is a graduate course of stratigraphy. The rocks are formed during the full geological time from oldest Precambrian to Recent Quaternary. This course is designed to understand the basic division of geological time scale (GTS). Different litho, bio and chorono stratigraphic divisions of time scale. This course is designed to acquire the knowledge about the various stratigraphic successions formed during different geological time. This will help the student to understand the stratigraphic set up of various regions, especially Pakistan. Initially, the basic principles and laws of stratigraphic will be teach in the class. Then the application of these laws/ principles is used to evaluate the structures and correlations of different geological features formed during the geological time will be understand by the students. This course also includes the principles of correlations.

Contents

1. Principles of stratigraphy;
2. Laws of superposition and faunal succession;
3. Geological time scale with divisions;
4. Classification and nomenclature of stratigraphic units
5. Lithostragraphic
6. Biostratigraphy and chrono stratgraphic units; contacts; litho-and-biofacies;
7. Principle of stratigraphy correlation;
8. Stratigraphy code of Pakistan;
9. Outline of stratigraphy of Pakistan; principles of biostratigraphy and biostratigraphy zones; biostratigraphy techniques and procedures; biostratigraphy of Pakistan.

Recommended Texts

1. Shah, S. I. (2000). *Stratigraphy of Pakistan*. Quetta: Geological Survey of Pakistan.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.

Suggested Readings

1. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy*. London: Pearson Education.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.

3. Shah, S. M. I. (1980). *Stratigraphy and economic geology of Central Salt Range*. Quetta: Geological Survey of Pakistan.

GEOL - 5107 **Mineralogy** **3(2+1)**

This course is a graduate level course of Mineralogy. As mineralogy is the sub discipline of geology which deals with the study of minerals. So the course is designed to acquire the knowledge about the physical and optical properties of various rock forming minerals and related phase diagrams. This will help the students in learning how various silicate and non-silicate minerals can be identified and how these are formed during different P-T conditions. It presents the important traditional content of mineralogy including crystallography, chemical bonding, controls on mineral structure, mineral stability, and crystal growth to provide a foundation that enables students to understand the nature and occurrence of minerals. Physical, optical, and X-ray powder diffraction techniques of mineral study will also be described in detail.

Contents

1. Introduction to mineralogy and crystallography
2. Classification of minerals
3. physical and optical properties of the common silicate and non-silicate mineral group
4. study of internal structure of minerals
5. Isomorphism, polymorphism and pseudomorphism
6. crystal systems
7. Elements of symmetry
8. Crystal notation
9. Study of normal classes of crystallographic systems.
10. crystal chemistry paragenesis
11. introduction to X-Ray diffractometry and universal stage and their application
12. Phase equilibrium studies
13. one component, binary and ternary system

Lab. Work

1. Megascopic and microscopic identification of common rock forming minerals
2. Construction and interpretation of phase diagrams from given experimental data
3. Lab work related to XRD and Universal stage.

Recommended Texts

1. Blackburn, W. H., & Dennen, W. H. (1994). *Principles of mineralogy*. New York: McGraw-Hill.

2. Dana, J. D. (2004). *Manual of Mineralogy.* Hoboken: John Wiley.

Suggested Readings

1. Nesse, W. D. (2016). *Introduction to mineralogy*. Oxford: Oxford University Press.
2. Nesse, W. D. (1991). *Introduction to optical mineralogy*. Oxford: Oxford University Press.
3. Pichler, H., & Schmitt-Riegraf, C. (2012). *Rock-forming minerals in thin section*. Berlin: Springer Science & Business Media.

URCE-5103 Academic Writing 3 (3+0)

Academic writing is a formal, structured and sophisticated writing tofulfill the requirements for a particular field of study. The course aims at providing understanding of writer's goal of writing (i.e. clear, organized and effective content) and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to the content logically to add specific details on the topics such as facts, examples and statistical or numerical values. The course will also provide insight to convey the knowledge and ideas in objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents

1. Academic vocabulary
2. Quoting, summarizing and paraphrasing texts
3. Process of academic writing
4. Developing argument
5. Rhetoric: persuasion and identification
6. Elements of rhetoric: Text, author, audience, purposes, setting
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Paragraph and essay writing
10. Organization and structure of paragraph and essay
11. Logical reasoning
12. Transitional devices (word, phrase and expressions)
13. Development of ideas in writing
14. Styles of documentation (MLA and APA)
15. In-text citations
16. Plagiarism and strategies for avoiding it

Recommended Texts

1. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
2. Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.

Suggested Readings

1. Craswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

BUSB - 5104 Introduction to Management 3(3+0)

This is an introductory course about the management of organizations. It provides instructions on principles of management that have general applicability to all types of enterprises; basic management philosophy and decision making; principles involved in planning, organizing, leading, and controlling; and recent concepts in management. Have you ever wondered what qualities billionaire Warren Buffet, visionary Steve Jobs, or Jeff Bezos all have in common? After you finish studying business practices in this course, you may discover that you have some of the same qualities as other successful entrepreneurs. This course is designed as a survey course that will expose you to business terminology, concepts, and current business issues. The intent is to develop a viable business vocabulary, foster critical and analytical thinking, and refine your business decision-making skills. The course will also encourage the students to explore and inquire the applicability of western management principles and theories in local settings.

Contents

1. Introduction to management the management process
2. Importance of management for a business
3. Organizational theories, Nature and types of organizations
4. The organizational culture and the management
5. The external environment and the manager
6. The internal environment and the manager
7. The manager's role as decision maker
8. Decision making process, Type of decision making processes
9. Basics of strategic management
10. Organizational structure, types of organizational structure,
11. Human Resource Management
12. Important of human resource for a business
13. Motivation its theories, team work and group behavior,
14. Leadership and its characteristics, leadership style and behavior ,
15. The process of control, case of controlling

Recommended Texts

1. Robbins, S. P., Coulter, M., & Langton, N. (2007). *Fundamentals of management*. Upper Saddle River: Pearson Prentice Hall.

Suggested Readings

1. Hannaway, J. (1989). *Managers Managing: The Workings of an Administrative System.* London: Oxford University Press.
2. Eccles, R. G. & Nohria, N. (1992). *Beyond the Hype: Rediscovering the Essence of Management*. Boston: The Harvard Business School Press.

GEOL - 5108 Petrography 3(2+1)

Petrography is a branch of petrology that focuses on detailed descriptions of rocks. Someone who studies petrography is called a petrographer. This course is designed to help the students to identify the minerals in sedimentary, igneous and metamorphic rocks using polarizing microscope and also classifying the rocks on the basis of rock texture and mineral composition. The mineral content and the textural relationships within the rock will be described in detail. The classification of rocks is based on the information acquired during the petrographic analysis. Petrographic descriptions start with the field notes at the outcrop and include macroscopic description of hand specimens. However, the most important tool for the petrographer is the petrographic microscope. The detailed analysis of minerals by optical mineralogy in thin section and the micro-texture and structure are critical to understanding the origin of the rock.

Contents

1. Introduction to polarizing microscope
2. Optical properties of opaque and non-opaque minerals in plane polarized light and under crossed nicol including metallic under reflected light
3. Description of optical properties of common rock forming minerals
4. Mineralogy and common texture of igneous, sedimentary and metamorphic rocks.

Lab. Work

1. Identification and description of common minerals
2. Study of rocks and minerals in thin section, texture and composition
3. Classification of rocks using different techniques, volume estimates and other elementary petrographic techniques.

Recommended Texts

1. MacKenzie, W. S., Adams, A. E., & Brodie, K. H. (2017). *Rocks and Minerals in Thin Section: A Colour Atlas*. Boca Raton: CRC Press.

2. Perkins, D., (2000), *Minerals in Thin Sections*. Upper Saddle River: Prentice Hall.

Suggested Readings

1. Klein, C. (2000). *Minerals and rocks: exercises in crystallography, mineralogy, and hand specimen petrology*. New York: Wiley.
2. Best, M. G. (2013). *Igneous and metamorphic petrology.* New York: John Wiley & Sons.
3. MacKenzie, W. S., & Guilford, C. (2014). *Atlas of the Rock-Forming Minerals in Thin Section*. London: Routledge.

GEOL – 5109 Igneous Petrology 3(2+1)

This course is a graduate level course of igneous petrology. It is the study of magma and the rocks that solidify from magma. The composition of igneous rocks and minerals can be determined via a variety of methods of varying ease, cost, and complexity. The simplest method is observation of hand samples with the naked eye and/or with a hand lens. This can be used to gauge the general mineralogical composition of the rock, which gives an insight into the composition. A more precise but still relatively inexpensive way to identify minerals (and there by the bulk chemical composition of the rock) with a petrographic microscope. It enables students to understand the mechanism of magma evolution as well as the factors affecting the magmatic evolution. This course also include the tectonic activities related to magmatic processes and different types of igneous rocks on different tectonic margins.

Contents

1. Igneous rock associations
2. Petrogenesis of igneous rocks
3. Petrogenic provinces: Basaltic provinces, Granite-granodiorite provinces and mafic-ultramafic complexes
4. Tectonism-magmatism relationship
5. Igneous activity related to convergent plate boundary and divergent plate boundary environments
6. Intracontinental hot spots
7. Continental rift related magmatism
8. Collisional and subduction environments and igneous activity
9. Ophiolites
10. Mantle-magma systems and source of magma
11. Physico-chemical factors in magmatic evolution.
12. Labs: Megascopic and microscopic identification and description of igneousrocks. Discrimination diagrams.

Recommended Texts

1. Winter, J. D. (2014). *Principles of igneous and metamorphic petrology*. London: Pearson Education.
2. McBirney, A. R. (1993). *Igneous petrology*. Burlington: Jones & Bartlett learning.

Suggested Readings

1. Wilson, B. M. (2007). *Igneous petrogenesis a global tectonic approach*. Springer Science & Business Media.
2. Blatt, H., Tracy, R., & Owens, B. (2006). *Petrology: igneous, sedimentary, and metamorphic*. New York: Macmillan.
3. Winter, J. D. (2000). *An introduction to igneous and metamorphic petrology* . New Jersey: Prentice hall.

GEOL - 5110 Structural Geology 3(2+1)

This course is a graduate course of structural geology. Different natural structures of earth are formed by the forces acting on the earth crust. This course is designed to acquire the knowledge about the deformational structures and their kinematics in the crust. This will help in understanding the deformational mechanism of various types of rocks and the mapping of the resultant structures. The major forces its classification is also included in this course. Different structures for example folds, faults, unconformities are formed by the forces acting on the surface of the earth. This curse is designed to first understand the phenomenon by which these structures are formed, their terminologies and classification of different structures. The lab work is included to enhance the knowledge about the practical use of the applications of engineering for the purpose of structural interpretations.

Contents

1. Stress, concept, classes, Mohr circle of stress,
2. Strain, types of strain, measures of strain, stress-strain diagram
3. Factor controlling the mechanical behavior of rocks
4. Fold Geometry
5. Mechanism of fold formation
6. Faults
7. Classification of faults
8. Foliation: Terminology, Classification
9. Lineation: Terminology, Classification
10. Unconformity: Terminology, Classification
11. Tectonites

Lab. Work

1. Map Exercise and construction of geological cross sections
2. Stereographic projections
3. Use of structural computer software.

Recommended Texts

1. Twiss, R. J., & Moores, E. M. (1992). *Structural geology*. New York: Macmillan.
2. Ragan, D. M., & Ragan. (2000). *Structural geology*. New York: John Wiley & Sons.

Suggested Readings

1. Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2011). *Structural geology of rocks and regions.* Burlington: John Wiley & Sons.
2. Park, R. G. (2013). *Foundation of structural geology*. London: Routledge.
3. Fossen, H. (2016). *Structural geology*. Cambridge: Cambridge University Press.

GEOL - 5111 Geological Fieldwork-II 3(0+3)

The second year field work will be performed for about two weeks. This course is designed to identify various types of rocks, field stratigraphy, fossils, structural features and landforms in the field. This will help the students to understand various types of criteria to recognize rocks and other geological features in the field. This course is designed to understand the geological mapping techniques in the field. This will help the students in learning the use of field equipments and data acquisition and preparation of geological maps and cross-sections. This course will help the students to get knowledge about various structures, features and other processes occurred in the field. The main goal of this subject is to acquire the fundamental geological field skill of mapping. The course emphasizes the basic skills essential to identify rocks according to different aspects , correlation & features also to locate yourself in the field and make essential field observations and measurements. Geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future.

Contents

1. Field based exercises;
2. Identification of major rocks.
3. field stratigraphy,
4. Fossils,
5. Structures of Igneous Rocks
6. Structure of Sedimentary rocks
7. Relief features
8. Contours and its types
9. Regional and detailed mapping
10. Section measurement.
11. Basic geological mapping techniques.
12. Each field trip will be followed by report writing and Viva Voce / Evaluation

Recommended Texts

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field.* New York: Wiley.

GEOL - 6112 **Geotectonics** **3(2+1)**

This course is designed to acquire the knowledge about the various types of plate boundaries, their kinematics and dynamics. The course comprises recent knowledge on structure and development of the Earth, especially of its crust and mantle. There are discussed older and new geological ideas concerning development of the crust, the accent is put on the plate tectonics. This will help the students to understand the mountain building activity and changes that occurred on the earth with the passage of time. In particular, it describes the processes of mountain building, the growth and behavior of the strong, old cores of continents known as crotons, and the ways in which the relatively rigid plates that constitute the Earth's outer shell interact with each other. Tectonics also provides a framework for understanding the earthquake and volcanic belts.

Contents

1. Concept of geosyncline and sedimentary basins
2. Sea floor spreading
3. Oceanic ridges and trenches
4. Continental rifts
5. Intra-oceanic islands
6. Hot spot and mantle plumes
7. Continental drift and reconstruction
8. Concept of plate tectonics
9. Historical perspective
10. Mechanism of plate tectonics
11. Plates and plate boundaries
12. Relative and absolute plate motions
13. Extensional, compressional and transpressional tectonics
14. Subduction zones
15. Transform and transcurrent faults
16. Introduction to neo-tectonics and related hazards

17. Application of geotectonic in natural resource explorations.

Lab Work

Specified assignments/projects.

Recommended Texts

1. Belousov, V. V., & Maxwell, J. C. (2000). *Basic problems in geotectonics*. New York, McGraw-Hill.
2. Keary, P., Vine, F., & Panza, G. F. (2000). *Global Tectonics.* Hoboken: Wiley-Blackwell.

Suggested Readings

1. Turcotte, D., & Schubert, G. (2014). *Geodynamics.* Oxford: Cambridge university press.
2. Belousov, V. V. (2000). *Fundamentals of geotectonics*. Moscow: Izdatel'stvo Nedra.
3. Cox, A., & Hart, R. B. (2009). *Plate tectonics: how it works*. Hoboken: John Wiley & Sons.

GEOL - 6113 Sedimentology 3(2+1)

This course is designed to acquire the knowledge about various types of sedimentary rocks and their digenesis. Sedimentary rocks illuminate many of the details of the earth's history: effects of sea level change, global climate, tectonic processes, and geochemical cycles are all recorded in the sedimentary strata of the earth. This course will cover basics of fluid flow and sediment transport, sedimentary structures and textures, and forming the bridge between modern landforms and ancient rocks' depositional sedimentary environments. This will help the students to understand the classification and depositional system of the sedimentary rock as well as the provenance of sediments and sedimentary structures. It’s also enable students to understand the role of tectonic for sedimentary rocks.

Contents

1. Introduction to sedimentology
2. Origin, transportation and deposition of sediments
3. Texture of sedimentary rocks and their statistical parameters
4. Sedimentary structures, their classification, morphology, significance and paleocurrent analysis
5. Classification and description of sedimentary rocks
6. Provenance of sediments; diagenesis; concepts of sedimentary facies and facies association
7. Physical-chemical controls of the sedimentary environments
8. Diagnostic features of glacial, eolian
9. Fluvial, lagoonal, acustrine, deltaic, tidal, turbidites and marine environments
10. Tectonic controls of sedimentation.

Lab. Work

1. Grain size analysis of sediments and sedimentary rocks,
2. Megascopic and microscopic study of sedimentary rocks for classification,
3. Use of ternary diagrams, discrimination diagrams for tectonic setting,

4. Separation and identification of heavy minerals,
5. Study of primary sedimentary structures and their uses in facing or top bottom,
6. Rose diagrams and paleocurrent analysis.

Recommended Texts

1. Prothero, D. R., & Schwab, F. (2004). *Sedimentary geology*. New York: Macmillan.
2. Pettijohn, F. J., Potter, P. E., & Siever, R. (2012). *Sand and sandstone*. Berlin: Springer Science & Business Media.

Suggested Readings

1. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy*. London: Pearson Education.
2. Reineck, H. E., & Singh, I. B. (2012). *Depositional sedimentary environments: with reference to terrigenous clastics*. Berlin: Springer Science & Business Media.
3. Selley, R. C. (2000). *Applied sedimentology*. Amsterdam: Elsevier.

GEOL - 6114 Geophysics 3(2+1)

Geophysics is the branch of Earth sciences which explores and analyzes active processes of the Earth through physical measurement. The undergraduate and graduate programs are designed to provide a background of fundamentals in science, and courses to coordinate these fundamentals with the principles of geophysics. This course is designed to acquire the knowledge about the seismic waves, seismic refraction, gravity, magnetic and electrical prospecting. This course will demonstrate understanding of fundamental physics concepts such as thermodynamics, electricity, magnetism, work, and force in geophysics. This will help the students in learning the basic techniques in geophysics and the students will also work on the seismic images and interpretation of subsurface structures. This course will enable students to predict the characteristic geophysical signatures of different rock types and structures for a number of geophysical methods and choose appropriate geophysical techniques for a given geologic environment and problem

Contents

1. Definition and relation of geophysics with other sciences
2. Classification and brief description of various branches of geophysics
3. Seismic reflection and refraction techniques
4. Geomagnetism
5. Geoelectricity
6. Tectonophysics
7. Gravimetry
8. Geothermy and geodesy
9. Geophysical data acquisition, processing and interpretation
10. Applications of geophysical techniques for exploration of mineral deposits
11. Oil, gas, subsurface water and engineering works
12. Introduction to earthquake seismology and geodynamics of earth

Recommended Texts

1. Robinson, E.S., & Coruh, C. (2000), *Basic Exploration Geophysics*. Hoboken: John Wiley and Sons.
2. Burger, H. R., Sheehan, A. F., & Jones, C. H. (2000). *Introduction to applied geophysics: Exploring the shallow subsurface*. Manhattan: WW Norton.
3. Telford, W. M., Geldart, L. P., & Sheriff, R. E. (2000). *Applied geophysics*. Cambridge: Cambridge University Press.

Suggested Readings

1. Dobrin, M.B. and Savit, C. H., (2000), *Introduction to geophysical prospecting*, New York: McGraw-Hill.
2. Sharma, P.V., (2000), *Geophysical methods in geology.* New York: Elsevier.
3. Kearey, P., and Brooks, M., (2000), *An introduction to geophysical exploration*. Oxford: John Wiley & Sons.
4. Robert J. Lillie, (2000), *Whole earth geophysics: an introductory textbook for geologists and geophysicists*. Upper Saddle River: Prentice Hall.

GEOL - 6115 **Field Geology** **3(3+0)**

This course is designed to understand the geological mapping techniques in the field. This will help the students in learning the use of field equipment's and data acquisition and preparation of geological maps and cross-sections. This course will help the students to get knowledge about various structures, features and other processes occurred in the field. The main goal of this subject is to acquire the fundamental geological field skill of mapping. The course emphasizes the basic skills essential to identify rocks according to different aspects , correlation & features also to locate yourself in the field and make essential field observations and measurements. Geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future. As geology is the subject of field and to explore the earth which is not possible without field work.

Contents

1. Introduction of topographic and geological maps.
2. Methods and techniques of surface and subsurface geological mapping.
3. Introduction to instruments for geological mapping.
4. Interpretation of geological maps with reference to outcrop patterns.
5. Correlation techniques.
6. Field description of igneous, metamorphic.
7. Modes of geological illustration including structural contour, isopach and lithofacies maps, block and fence diagrams.
8. Scan line survey.
9. Preparation of geological maps and cross sections.
10. Awareness and compliance of Health and Safety Environment (HSE) particularly during geological work.
11. Structure of sedimentary rocks.

12. Regional and detailed mapping.

Recommended Texts

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field.* New York: Wiley.

GEOL - 6116 Micropaleontology 3(2+1)

This course is designed to understand the micro-fossils found in geological formations and Tertiary biostratigraphy rock units in Pakistan. Micropaleontology is concerned with microfossils and nanno fossils, the study of which must, of necessity, be carried out using the light or electron microscope. To achieve this course, the microfossil must be studied in terms of morphology, structure, chemical and mineralogical composition and taxonomy to discover their origin and systematic affinities. The course is designed to acquire knowledge about the microfossils and micro-organisms and their role in interpretation of depositional environment. This will help the student to identify various types of microfossils and to understand their role in depositional systems of major sedimentary basins. Application of these microfossils in the field of oil-exploration, biostratigraphy, paleobiology and paleoclimatology is essential. This subject emphasizes on the microfossils that lived in or under sea water.Thus, interaction with the present-day physical, chemical and biological characteristics of the ocean water will be also addressed. The course will introduce the major marine and non-marine invertebrate taxonomic groups found in the fossil record and what we know about them – their stratigraphic range, modes of life, and environmental preferences.

Contents

1. Introduction to Micropaleontology and its applications
2. Detail classification of marine environments,
3. Genus Miscellanea, Assilina, Ranikothalia, Lockhartia
4. Nummulites, Discocylina, Orbitolites, Globotrucana
5. Introduction to Foraminifera, Bryozoa, Conodonts,
6. Algae, pollen and spores;
7. Microfossils and nanoplanktons;
8. Principles of Biostratigraphy and Biostratigraphic zones;
9. Biostratigraphic techniques and procedures;

10. Morphological and taxonomic studies of selected micro fossils
11. KT Boundary and its presence in Pakistan
12. Tertiary biostratigraphy with special reference to Pakistan

Recommended Texts

1. Saraswati, P. K., & Srinivasan, M. S. (2015). *Micropaleontology: principles and applications.* New York: Springer.
2. Brasier, M. D. (1980). *Microfossils.* London: G. Allen & Unwin.

Suggested Readings

1. Haq, B. U., & Boersma, A. (Eds.). (2000). *Introduction to marine micropaleontology*. New York: Elsevier.
2. McGowran, B. (2000). *Biostratigraphy: microfossils and geological time.* Cambridge: Cambridge University Press.
3. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy.* London: Pearson Education.

GEOL - 6117 Introduction to GIS and RS 3(2+1)

This course is designed to introduce principles, concepts and applications of Geographic Information Systems (GIS) and Remote Sensing (RS): a decision support tool for planners and managers of spatial information and to obtain information on the earth from decimeter level to km level locally and globally. The catalog description is to introduction concepts, terminology, methods of Geographic Information System (GIS) technology and mapping science. The main Purpose and Objectives of Course is to gain a basic, practical understanding of GIS concepts, techniques and real world applications Class discussions, reading assignments, and class lectures prepare students to develop a mapping project based on the assumptions and interpretations of data selected by the student.

Contents

1. Introduction to Geographical Information System
2. Data types, data models and structures
3. Data sources and capturing techniques
4. Displaying and manipulating spatial information
5. Introduction to the concept of RS
6. Technology of Remote Sensing (Orbits, Satellites, Sensors and Platforms)
7. Applications of Remote Sensing, satellite image processing cycle
8. Mosaicing and information extraction (classification and vectorization)
9. Have a basic, practical understanding of GIS concepts, techniques and real world Applications.
10. Have an understanding of the technical language of GIS.
11. Know how GIS is utilized in the larger context of business needs and IT strategies.
12. Understand the basic concepts of geography necessary to efficiently and
13. Accurately use GIS technology.

14. Understand basic GIS data concepts.
15. Have an ability to perform basic GIS analysis of concepts.
16. Have demonstrated a practical application of GIS.
17. Have practical experience using basic GIS tools.
18. Have an understanding of GIS and its relationship to mapping software development.
19. Have an appreciation of GIS career options and how to pursue them.

Recommended Texts

1. Gupta, R. P. (2017). *Remote sensing geology*. Heidelberg: Springer.
2. Chang, K. T. (2008). *Introduction to geographic information systems*. Boston: McGraw-Hill.

Suggested Readings

1. Duckham, M., Goodchild, M. F., & Worboys, M. (Eds.). (2004). *Foundations of geographic information science*. Boca Raton: CRC Press.
2. DeMers, M. N. (2008). *Fundamentals of geographic information system*s. Hoboken: John Wiley & Sons.

GEOL - 6118 Sequence Stratigraphy 3(2+1)

This course is designed to acquire the knowledge about various types of stratigraphic sequences and their relation with the sea level changes. This will help the students to learn about the formation of various sedimentary rock sequences during geologic time. The goal of the course is to introduce the students to sequence stratigraphy and show how sequence stratigraphy can be applied to better understand how sedimentary successions are structured in a temporal-spatial perspective and which controls play part in this structure. Within the course basic concepts, principles and methods in sequence stratigraphy are presented, including how sequences can be subdivided into genetic units and which processes controls the sequence development through time. The principles are illustrated with examples and students may participate the methods during geological fieldwork in outcrops. Students can describe and analyze sedimentary successions with focus on interpretation of sedimentary environments and sequence stratigraphy. They may identify genetically related units and their intervening discontinuity surfaces. And can assess which control is instrumental for the stacking and geometry of sedimentary sequences.

Contents

1. Sequence Stratigraphy – An Overview, Historical Development of Sequence Stratigraphy, Sequence Stratigraphic Approach
2. Methods of Sequence Stratigraphic Analysis, Introduction, Facies Analysis: Outcrops, Core and Modern Analogies, Well Logs, Seismic, Accommodation and Shoreline Shift, Allogenic Controls on Sedimentation, Sediment Supply and Energy Flux, Sediment Accommodation, Shoreline Trajectories.
3. Stratigraphic Surfaces, Types of Stratal Terminations, Sequence Stratigraphic Surfaces
4. System Tracts including HST, FSST, LST, TST, RST
5. Sequence Models: Types of Stratigraphic Sequences, Parasequences in Fluvial System,

Parasequences in Coastal to Shallow Water Clastic System
6. Time attribute of Sequence Stratigraphic Surfaces
7. Hierarchy of Sequences and Sequences Boundaries
8. Discussions and Conclusions, Future Directions.

Recommended Texts

1. Catuneanu, O. (2000). *Principles of sequence stratigraphy*. Amsterdam: Elsevier.
2. Miall, A. D. (2010). *The geology of stratigraphic sequences*. New York Springer Science & Business Media.

Suggested Readings

1. Slatt, R. M. (2000). *Stratigraphic reservoir characterization for petroleum geologists, geophysicists, and engineers*. Amsterdam: Elsevier.
2. Emery, D. and Myers, K.J., (2000). *Sequence Stratigraphy*. Oxford: Blackwell.
3. Embry, A. F. (2009). *Practical sequence stratigraphy*. Alberta: Canadian Society of Petroleum Geologists.

GEOL - 6119 Geochemistry 3(2+1)

This is the sub discipline of geology which deals with the study of the chemical composition of the earth and its rocks and minerals. This course is designed to acquire the knowledge about the distribution of elements in minerals and rocks and their dispersion in different environments. This will help the students in learning the geochemical characteristic of various rocks and their role in mineral exploration. One of the goals of geochemistry is to determine the abundance of elements in nature, as this information is essential to hypotheses development about the origin and structure of our planet and the universe. An element is material which has a particular kind of atom with specific electronic structure and nuclear charge, factors that determine their abundance in the rocks. Regarding distribution, it can only have direct evidence on the composition of the Earth's crust and indirect on the mantle and core.

Contents

1. Development of geochemistry as a discipline
2. Composition of meteorites, Origin and cosmic abundance of elements
3. Geochemical structure of the earth, Geochemical classification of elements
4. Polymorphism and pseudomorphism; geochemical cycle
5. Mobility and dispersion of elements under different geochemical environments
6. Introduction to geochemistry of igneous, metamorphic and sedimentary rocks
7. Geochemical anomalies and their application in mineral exploration
8. Introduction to geochemical analytical techniques
9. Introduction to organic geochemistry, organic matter, types, and its importance in petroleum industry.

Lab. Work

1. Processing and interpretation of geochemical data
2. Ternary diagrams interpretation.

Recommended Texts

1. Krauskopf, K. B. (2000), *Introduction to geochemistr*. New York: McGraw-Hill.
2. Mason. B., (2000) *Principles of geochemistry*. Hoboken: John Wiley and Sons.
3. Beaumont, E.A. & Foster, N.H. (1988), *Geochemistry*. Texas: AAPG.

Suggested Readings

1. Rose, A.W., Hawkes, H.H. and Webb, J.S. (2000), *Geochemistry in mineral exploration*. Tonbridge: Whitstable Litho Ltd.
2. Henderson, P. (2000). *Inorganic geochemistry*. *organic photonics and photovoltaics*. Upper Saddle River: Prentice Hall.
3. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2000). *Geochemistry: Pathways and processes*. New York: Columbia University Press.

GEOL - 6120 **Petroleum Geology** **3(2+1)**

This course is designed to acquire the knowledge about the processes involved in the formation, migration and accumulation of petroleum in the rocks and drilling and well logging techniques for petrophysical evaluation and production of oil and gas. It introduces students to the key issues surrounding being a geologist in the petroleum industry. With the changing nature of hydrocarbon exploration and production, both conventional and unconventional hydrocarbons are considered. The key concepts of the origin and generation of hydrocarbons, reservoir rocks and subsurface reservoir structures (traps) are introduced, together with some of the key techniques used within the industry (e.g. reservoir geology, petrophysics and formation evaluation). Practical issues such as how hydrocarbon wells are drilled and how rocks are sampled in the subsurface are also considered. This will help the students to learn about the global occurrences of oil and gas with special emphasis on Pakistan so that they can effectively use their knowledge in the exploration and development of the country's energy resources.

Contents

1. Introduction and history of hydrocarbon exploration
2. The nature and classification of petroleum hydrocarbons
3. Origin, migration and accumulation hydrocarbon
4. Traps, seal and cap rocks
5. Source rock-evaluation; Kerogene and its types
6. Reservoir rocks characterization, reservoir fluid, reservoir conditions and dynamics; tight reservoirs
7. Exploration petroleum cycle in Pakistan; prospect and exploration in frontiers areas
8. Introduction to drilling operations, well site geology and mud logging
9. Well failure/success analysis

10. Petroleum prospect risk analysis
11. Nonconventional hydrocarbons
12. Introduction to play fairways and petroleum system

Recommended Texts

1. North, F.K., (2000). *Petroleum geology*. Boston: Allen and Unwin.
2. Selley, R. C., & Sonnenberg, S. A. (2014). *Elements of Petroleum Geology*. Cambridge: Academic Press.

Suggested Readings

1. Bjorlykke, K. (2010), *Petroleum geoscience: from sedimentary environments to rock physics*. Amsterdam: Springer.
2. Levorsen, A. I. & Berry, F. A. (2000). *Geology of petroleum*. San Francisco: WH Freeman.
3. Hyne, N. J. (2012). *Nontechnical guide to petroleum geology, exploration, drilling, and production*. Tulsa: PennWell Books.

GEOL - 6121 Engineering Geology 3(2+1)

This course is a graduate course of engineering geology. This course is designed to acquire the knowledge about the rock mechanics and their role in the construction of huge structure. The construction of buildings, underground excavations, dams on different rock masses like igneous, sedimentary and metamorphic rocks requires the data of basic physical and geological and geotechnical parameters. So, this course will help the students in learning various techniques for the determination of physical and geotechnical parameters of soils and rocks for construction of buildings and foundations. The building code of Pakistan for the construction of various structures and buildings under various geological conditions is also included in this course. The study of common problems during the construction of structures is also included in this course and will help the students to discuss about the various natural and man-made problems. Lab work is also included to enhance the practical knowledge of students.

Contents

1. Introduction to the engineering geology and its application
2. Weathering, physical and chemical
3. Earthquakes, causes and intensity scale
4. Rock mass classification
5. Geotechnical studies of rocks and soils
6. Geological factors and strength of rocks
7. Chemical and mechanical behavior of rocks
8. Geotechnical investigation; uses of sedimentary, igneous and metamorphic rocks as construction material
9. Building Code of Pakistan

10. Dam and tunnel engineering
11. Common engineering problems and their remedial measures

Lab. Work

1. Sieve analysis
2. Moisture, void ratios, porosity
3. Angle of repose, and other geotechnical properties of soils.
4. Uniaxial and Triaxial Testing; tensile, compressive and shear tests of rocks.

Recommended Texts

1. Price, D. G. (2008). *Engineering geology: principles and practice*. Amsterdam: Springer Science & Business Media.
2. Bell, F. G. (2004). *Engineering geology and construction*. Boca Raton: CRC Press.

Suggested Readings

1. Bell, F. G. (2016). *Fundamentals of engineering geology*. Amsterdam: Elsevier.
2. Beavis, F. C. (1985). *Rock weathering. Engineering Geology*. Melbourne: Blackwell Scientific.

GEOL - 6122 Metamorphic Petrology 3(2+1)

This course is designed to expose the students to the solid state transformation of pre-existing igneous, metamorphic and sedimentary rocks into metamorphic rocks. This course is a basic to advance introduction for the post graduate students in petrology. Geology is plagued by the problem of in accessibility; they see only the tiny fraction of the rocks that composes the Earth. During the processes of uplift and the erosion on the surface, but their exact place of origin is vague. As a result, a large proportion of our information about earth is indirectly coming from analysis of subsurface materials, geophysical studies, or experiments conducted at variable temperature and pressure. Metamorphic rocks are the most common rock type on Earth, and their study allows us to put constraints on the pressure, stress and temperature conditions in the crust and mantle, and on the bulk composition in these environments. Metamorphism affects rocks in three ways; it changes their mineralogy, it changes their shape, and it can change their composition.

Contents

1. Introduction to metamorphism
2. Types, grades, zones and facies of metamorphism
3. Metamorphic diffusion and differentiation
4. Study of thermal and regional metamorphism of igneous, argillaceous, calcareous and arenaceous rocks
5. Metamorphism in relation to plate tectonics
6. Study of textures and structures of metamorphic rocks
7. Metamorphism and deformation; history and dating of metamorphic rocks
8. Differentiation between metamorphism and metasomatism

9. Paired metamorphic belts
10. Himalayan and pre-Himalayan metamorphism in Pakistan.

Lab. Work

1. Petrographic and hand specimen identification of metamorphic textures, structures, and metamorphic history of rocks.
2. ACF and AKF ternary diagrams and petrogenesis.

Recommended Texts

1. Best, M, G. (2013). *Igneous and metamorphic petrology*. Honoken: John Wiley & Sons.
2. Hyndman, D. W. (2000). *Petrology of igneous and metamorphic rocks*. New York: McGraw-Hill.

Suggested Readings

1. Gillen, C. (2012). *Metamorphic geology: an introduction to tectonic and metamorphic processes.* Amsterdam: Springer Science & Business Media.
2. Philpotts, A. & Ague, J. (2009). *Principles of igneous and metamorphic petrology*. Cambridge: Cambridge University Press.
3. Yardley, B. W., & Yardley, B. W. D. (1989). *An introduction to metamorphic petrology*. New York: McGraw-Hill.

GEOL - 6123 Geological Fieldwork- III 3(0+3)

This course is designed to understand the geological mapping techniques in the field. This will help the students in learning the use of field equipment and data acquisition and preparation of geological maps and cross-sections. This course will help the students to get knowledge about various structures, features and other processes occurred in the field. The main goal of this subject is to acquire the fundamental geological field skill of mapping. The course emphasizes the basic skills essential to identify rocks according to different aspects, correlation & features also to locate yourself in the field and make essential field observations and measurements. Geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future. As geology is the subject of field and to explore the earth which is not possible without field work. The students will be able to carry out observation and plotting of geological information on topographic sheet. They will be able to study of geomorphic features in field and measurement of stratigraphic sections. Independently carry out recognition of structural features and study of fossils, primary and secondary structures. This geological fieldwork exercise will enable students to describe various features sedimentary, igneous and metamorphic rocks

Contents

1. Field based exercises
2. Topographic sheets and its utilization in field.
3. Observation and plotting of geological information on topographic sheet.
4. Study of geomorphic features.

5. Measurement of stratigraphic sections.
6. Recognition of structural features.
7. Study of fossils
8. Study of primary and secondary geological structures.
9. Field description of sedimentary, igneous and metamorphic rocks.
10. Report writing based on geological mapping of an assigned area and fieldwork Viva Voce and Evaluation.

Recommended Texts

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field* . New York: Wiley.

GEOL - 6124 Geology of Pakistan 3(3+0)

This course is designed to acquire the knowledge about the tectono-stratigraphy of Pakistan with special emphasis on the tectonic elements and minerals and fuel deposits. This will help the students to learn about the interaction of regional plates and blocks such as Indian Plate, Arabian Plate, Karakoram Plate, and Afghan Block through geological times and their influence on the stratigraphy and mineral deposits of Pakistan. The core objective of this subject is to provide the detail Geological and Tectonics Setting of Pakistan by introducing the Geodynamcis setting of Pakistan. It is the study which describes the Mineral exploration and its exploitation, exploration and development Oil and Gas resources, Metallic and non-metallic mineral resources, suitable aggregate study for construction materials, dams side studies, earthquake studies and mega Infrastructure related. It also describes about the various tectonics elements for collisional, extensional and transform plate boundary setting. From the formation of mighty Himalayas, it includes the detail tectonosedimentary, metamorphic and deformation mechanism. It will also focuses on the occurrences of Active Seismic Zones of Pakistan and earthquake seismology scenario.

Contents

1. Physiographic and tectonic divisions of Indo Pak Plate and its descriptions.
2. Geology and stratigraphy of the Indian plate, Karakoram plate.
3. Afghan block and Arabian plate.
4. Waziristan , Kohistan, Chagai and Ras Koh magmatic Arcs.
5. Sedimentary basins of Pakistan.
6. Makran subduction complex.

7. Chaman transform zone, arcs, oroclines and suture zones.
8. Tertiary Himalayan and pre-Himalayan orogenic events.
9. Late Precambrian to Early Cambrian Hazaran orogeny.
10. Regional metamorphism (Himalayan and pre-Himalayan).
11. Main episodes of magmatism and their relations to tectonics.
12. Economic mineral and fuel deposits of Pakistan.

Recommended Texts

1. Kazmi, A. H., & Jan, M. Q (1997). *Geology and tectonics of Pakistan*. Karachi: Graphic publishers.
2. Bender, F.K. & Raza, H.A. (1997). *Geology of Pakistan*. Berlin: Oxford University Press.

Suggested Readings

1. Farah, A., Abbas, G., De Jong, K. A., & Lawrence, R. D. (1984). Evolution of the lithosphere in Pakistan. *Tectonophysics*, *105*(1-4), 207-227.
2. Searle, M. (2013). *Colliding continents: a geological exploration of the Himalaya, Karakoram, and Tibet*. Oxford: Oxford University Press.
3. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan* . Peshawar: National Centre of Excellence in Geology.

GEOL - 6125 **Economic Geology** **3(2+1)**

This course is designed to acquire the knowledge about the formation of various types of economic mineral deposits and their significance. This will help the students to understand the processes which are involved in the genesis of various ores deposits, hydrocarbons, gemstones and other industrial minerals. Upon successful completion, students will have the knowledge and skills to recognize common ore minerals in hand samples and under the microscope demonstrate familiarity with a wide range of mineral deposits, including recognizing the overall geometry, zonation and alteration patterns associated with specific classes of metallic mineral deposits Relate overall geometry, zonation and alteration patterns of rock associations to specific classes of metallic mineral deposits. Evaluate different processes of element enrichment by fluids and melts to from ore bodies. Inform peer students and the wider public how understanding the formation of ore bodies is important in the current debates about global resources.

Contents

1. Introduction to economic minerals and rocks and their classification,
2. Grade and reserve estimation of deposits, Introduction to ore microscopy
3. Environment and processes of formation of economic mineral deposits: magmatic segregation, hydrothermal solution, metasomatism, sedimentation, evaporation, residual and mechanical concentration and metamorphism,
4. Relationship of mineral deposits to plate tectonic settings,
5. Introduction of geological exploration/prospecting,
6. Brief description of economic minerals such as fuel minerals, gemstones, copper, lead, zinc, iron,

gold, chromite, manganese, salt, gypsum, bauxite, sulphur, barite, fluorite, clays, phosphorite, building and dimension stones, industrial rocks and minerals, radioactive minerals and rocks with special reference to Pakistan.

Lab. Work

Identification and description of economic minerals, microscopic studies and lab exercises on grade and reserve estimation from provided data.

Recommended Texts

1. Evans, A. M. (2009). *An introduction to economic geology and its environmental impact*. Hoboken: John Wiley & Sons.
2. Pohl, W. L. (2011). *Economic geology: principles and practice*. Hoboken: John Wiley & Sons.

Suggested Readings

1. Moon, C. J., Whateley, M. K., & Evans, A. M. (2006). *Introduction to mineral exploration* (2nd ed.). Hoboken: Blackwell publishing.
2. Park Jr, C. F., & MacDiarmid, R. A. (1975). *Ore deposits*. San Francisco, Freeman.
3. Evans, Anthony M. (2009). Ore geology and industrial minerals: an introduction. Hoboken: John Wiley & Sons.

GEOL - 6126 Environmental Geology 3(2+1)

This course is designed to acquire the knowledge about the role of geology in the environmental degradation. As a discipline, environmental geology deals with using geological knowledge to address interactions between humans and the physical environment: the biosphere, the lithosphere, the hydrosphere, and, to some degree, the atmosphere. Environmental geology is a multidisciplinary subject that covers a broad range of topics, ranging from Earth materials and their use to Earth processes, including natural hazards and their impact on human lives. The environmental effects of exploring Earth resources is also an integral component of the course. This will help the students to learn how the various geological processes and related human activities are involved in contaminating our ecosystem. managing geological and hydrogeological resources such as fossil fuels, minerals, water (surface and ground_water), and land_use. Studying the earth's surface through the disciplines of geomorphology, and defining and mitigating exposure of natural hazards on humans managing industrial and domestic waste disposal and minimizing or eliminating effects of pollution, and performing associated activities, often involving litigation.

Contents

1. Introduction to environmental geology, management of natural resources, climatic changes.
2. Environmental controls for erosion, desertification and coastal degradation.
3. Introduction to environmental impact assessment and initial environmental examination.
4. Environmental impact of mining, dams, reservoirs.
5. Environmental impact of Highways, their assessment and controls.
6. Geological hazards such as floods, landslides.

7. Earthquakes, tsunamis, volcanoes.
8. Glaciers and shoreline processes and their remedial measures;
9. Industrial pollution, solid and liquid waste disposal.
10. Groundwater contaminations.
11. River lake and marine pollution and their impact on human health.
12. Clean sources of energy, introduction to acid mine drainage.

Recommended Texts

1. Pipkin, B. W., Trent, D. D., Hazlett, R., & Bierman, P. (2013). *Geology and the Environment*. Boston: Cengage Learning.
2. Knödel, K., Lange, G., & Voigt, H. J. (2007). *Environmental geology: handbook of field methods and case studies*. Amsterdam: Springer Science & Business Media.

Suggested Readings

1. Montgomery, C. W. (1992). *Environmental Geology*. Dubuque: Wm C. Brown Publishers.
2. Armand, N. A., & Polyakov, V. M. (2004). *Radio propagation and remote sensing of the environment*. New York: CRC Press.
3. Pipkin, B. W., Trent, D. D., Hazlett, R., & Bierman, P. (2013). *Geology and the Environment*. Boston: Cengage Learning.

GEOL - 6127 Hydrogeology 3(2+1)

This course is a graduate course. One of the elective advance level courses in the group of specialization in Engineering Geology is Hydrology. This course is designed to acquire knowledge about the exploration of groundwater resources and their management. This will help the students to learn how to manage and conserve water resources, how to overcome the acute shortage of water supply and also how to maintain its purity for meeting the present demand as well as the demand of the further generation. The process of installation of tube wells, its techniques, designing and developments. Flow-net analysis using pumping tests. You will gain a wide understanding of hydrological processes and phenomena, including but not limited to groundwater. Other associated topics teach you the critical interrelationships groundwater has with surface water hydrology and vegetation, amongst others. After completing these courses, the students will be able to carry out their independent research on the site development for construction.

Contents

1. The hydrologic cycle
2. Aquifer system and types
3. Occurrence and movement of groundwater
4. Hydrological properties of rocks and their measurements
5. Fluctuation of groundwater levels and causes
6. Recharge and discharge of ground water
7. Groundwater exploration by geological, hydro-geological and geo-physical methods and remote sensing techniques

8. Well hydraulics
9. Tube well drilling techniques, designing, development
10. Flow-net analysis and pumping tests, water logging and causes of water table declination

Recommended Texts

1. Davie, T. (2008). *Fundamentals of hydrology*. London: Routledge.
2. Hiscock, K. M. (2009). *Hydrogeology: principles and practice*. Hoboken: John Wiley & Sons.

Suggested Readings

1. Todd, D. K., & Mays, L. W. (2005). *Groundwater hydrology*. Hoboken: Welly.
2. Prickett, T. A., & Lonnquist, C. G. (1971). Selected digital computer techniques for groundwater resource evaluation. Bulletin (Illinois State Water Survey) no. 55.
3. Franklin, J. A., & Dusseault, M. B. (1989). *Rock engineering*. New York: McGraw-Hill.

GEOL - 6130 **Geochemistry II** **3(2+1)**

This is the sub discipline of geology which deals with the study of the chemical composition of the earth and its rocks and minerals. The course is designed to acquire the knowledge about the distribution of elements in minerals and rocks and their dispersion in different environments. This will help the students in learning the geochemical characteristic of various rocks and their role in mineral exploration. One of the goals of geochemistry is to determine the abundance of elements in nature, as this information is essential to hypotheses development about the origin and structure of our planet and the universe. An element is material which has a particular kind of atom with specific electronic structure and nuclear charge, factors that determine their abundance in the rocks. Regarding distribution, it can only have direct evidence on the composition of the Earth's crust and indirect on the mantle and core.

Contents

1. Geochemistry of igneous, sedimentary and metamorphic rocks
2. Modal analysis for classification
3. Chemical characterization and identification of minerals
4. Classification and distribution of elements in the earth crust
5. Introduction to analytical geochemistry
6. Causes for geochemical diversity in the igneous rocks
7. Geochemical characteristics of igneous rocks as petrogenetic indicators
8. Processes which modify the composition of primary magmas

9. Geochemical characteristics of different magma series
10. Geothermometry and geobarometry
11. Metasomatic processes and environment.

Lab. Work

1. Characterization of igneous rocks on the basis of their (a) modal and (b) chemical composition
2. Calculation of normative composition from the major element chemistry of igneous rocks
3. The use of major and trace element composition of igneous rocks as a means to determine their paleotectonic setting

Recommended Texts

1. Rollinson, H. R. (2014). *Using geochemical data: evaluation, presentation, interpretation.* London: Routledge.
2. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2003). *Geochemistry: Pathways and processes.* Columbia: Columbia University Press.

Suggested Readings

1. Krauskopf, K. B., & Bird, D. K. (2007). *Introduction to geochemistry* (Vol. 72, No. 1). New York: McGraw-Hill.
2. Best, M. G. (2013). *Igneous and metamorphic petrology*. New York: John Wiley & Sons.

GEOL-6132 Metamorphic Petrology II 3(2+1)

This course is a graduate level course of metamorphic petrology. It enables students to understand the mechanism and types of metamorphism as well as the factors that affect the process of metamorphism. This course also includes different rock structures which developed due to metamorphism so it's beneficial for students to recognize different rock features in metamorphic rocks of field area. Metamorphic petrology covers the chemical and physical work done in natural systems in response to changing physical conditions. Petrogenetic processes such as recrystallization, continuous and discontinuous reactions, mixed volatile reactions and deformation are addressed. The principles of metamorphic petrology are then applied to a number of orogenic events through geologic time, and modern advances in research in metamorphic petrology are explored.

Contents

1. Basic characteristics of metamorphic reactions and role of fluids
2. Concept of iso-grades and iso-reaction grades
3. Very low grade and ocean floor metamorphism
4. Cataclastic metamorphism
5. Metamorphic facies series
6. P-T gradients
7. Mineralogical charactersistics of individual facies
8. Progress metamorphism of pelites, basic rocks and carbonates
9. High grade metamorphism, anatexis and migmatites

10. Tectonics of regional metamorphic belts
11. Paired metamorphic belts, Metamorphic structure of continental crust.

Lab. Work

1. Construction and interpretation of ACF and AKF diagrams
2. Petrographicstudy of various rocks suites
3. Mineral and mineral phase equilibria and P-T conditions.

Recommended Texts

1. Best, M. G. (2013). *Igneous and metamorphic petrology*. New York: John Wiley & Sons.
2. Vernon, R. H., Vernon, R. H., Vernon, R., & Clarke, G. L. (2008). *Principles of metamorphic petrology*. Cambridge: Cambridge University Press.

Suggested Readings

1. Gillen, C. (2012). *Metamorphic geology: an introduction to tectonic and metamorphic processes.* Amsterdam: Springer Science & Business Media.
2. Philpotts, A., & Ague, J. (2009). *Principles of igneous and metamorphic petrology*. Cambridge: Cambridge University Press.
3. Yardley, B. W., & Yardley, B. W. D. (1989). *An introduction to metamorphic petrology*. New York: John Wiley & Sons.

GEOL - 6134 Mineralogy II 3(2+1)

This course is a graduate level course of Mineralogy. Advance mineralogy is a subject of geology specializing in the scientific study of the chemistry, crystal structure, and physical (including optical) properties of minerals and mineralized artifacts. So the course is designed to acquire the knowledge about the physical and optical properties of various rock forming minerals and to develop a relationship between the structure chemistry and properties of silicates, carbonates, oxides, sulphides, and phosphate. This will help the students in learning the mechanisms of mineral nucleation, crystal growth and importance of kinetics in mineral formation as well as by using different computer programs, they will be able to calculate mineralogical parameters.

Contents

1. Physical and chemical properties of mineral
2. Relationship between the structure chemistry and properties of Silicates, carbonates, oxides, sulphides, and Phosphate
3. Physical and chemical properties of minerals
4. Mechanisms of mineral nucleation and crystal growth
5. Importance of kinetics in mineral formation
6. Interpretation of mineral analysis
7. Recalculation of a mineral analysis in terms of fixed number of anions, and, where appropriate, cations

8. Measurement of mineral triple junction angles
9. Description of grain boundaries and their implication for the development of rock textures
10. Use of computer programs, including spreadsheets, to calculate mineralogical parameter
11. Triangular and X-Y plots
12. Related mineralogical information to the assessment and performance of industrial rocks and minerals.

Recommended Texts

1. Perkins, D. (1998). *Mineralogy. In the Beginning*. Upper Saddle River: Prentice Hall.
2. Deer, W. A. (2011). *Rock-forming minerals*. London: Geological Society of London.

Suggested Readings

1. Perkins, D., and Henke, K.R., 2000, Minerals in Thin Section. Upper Saddle River: Prentice Hall.
2. Philpotts, A. R. (1989). *Petrography of igneous and metamorphic rocks*. Upper Saddle River: Prentice Hall.
3. MacKenzie, W. S., & Guilford, C. (2014). *Atlas of the Rock-Forming Minerals in Thin Section*. London: Routledge.

GEOL - 6135 **Rock Mechanics** **3(2+1)**

This course is a graduate course. One of the elective advance level courses in the group of specialization in Engineering Geology is Rock Mechanics. The course will enable the students to fully understand the basic knowledge about the stress and strain. The behavior of rocks under different geological stress regimes. The measurement the in-situ stresses around the periphery of underground excavations. The qualities of rock masses are very important to be studied for the overall estimation of rock mass deformation and strength of the rocks. These current and hot topic of rock mechanics is also included in the outline of subject and will enhance the practical knowledge about the mechanics of rocks. For the completion of course, special assignments of testing of uniaxial and triaxial conditions are also included. After completing these courses, the students will be able to carry out their independent research on the site development for construction.

Contents

1. Fabric and mechanical nature of rocks;
2. Determination of rock quality for engineering purposes;
3. Stress strain behaviors of different rocks; rock mass strength. Theories of failure;
4. Types of fracture; rock deformation in compression;
5. Factors controlling mechanical behaviors of rocks; excavation methods in rocks;

6. Distribution of stresses around underground excavations;
7. Use of photo elasticity in rock mechanics.
8. Measurement of stresses in situ; wave propagation in rocks; dynamic models.

Lab. Work

Special Assignments/Projects

Recommended Texts

1. Brady, B. H., & Brown, E. T. (2013). *Rock mechanics: for underground mining*. Amsterdam: Springer science & business media.
2. Duncan, N. (2000). *Engineering Geology and Rock Mechanics*. London: Leonard Hill

Suggested Readings

1. Li, D., Hyslip, J., Sussmann, T., & Chrismer, S. (2002). *Railway geotechnics*. Boca Raton: CRC Press.
2. Franklin, J. A., & Dusseault, M. B. (1989). *Rock engineering*. Abingdon: Routledge.

GEOL – 6136 Soil Mechanics 3(2+1)

Soil Mechanics is a sub discipline Engineering geology involving the study of soil, its behaviour and application as an engineering material. Soil Mechanics is the application of laws of mechanics and hydraulics to engineering problems dealing with sediments and other unconsolidated accumulations of solid particles, which are produced by the mechanical and chemical disintegration of rocks, regardless of whether or not they contain an admixture of organic constituents. Soil consists of a multiphase aggregation of solid particles, water, and air. This fundamental composition gives rise to unique engineering properties, and the description of its mechanical behavior requires some of the most classic principles of engineering mechanics.

Contents

1. Introduction
2. Concept of soil mechanics,
3. Soil formation
4. Classification,
5. survey and sampling with its important engineering properties like soil gradin
6. Moisture contents
7. Void ratios, density, permeability

8. Shearing strength, bearing capacity
9. Consolidation and settlements.

Lab. Work

1. Index properties of soil.
2. Determination of soil density, permeability,unconfined shearing and compressive strength of soil and Attenberg's limits.

Recommended Texts

1. Nelson, J., & Miller, D. J. (1997). *Expansive soils: problems and practice in foundation and pavement engineering*. New York: John Wiley & Sons. .
2. Attewell, P. B., & Farmer, I. W. (2012). *Principles of engineering geology*. Springer Science & Business Media.

Suggested Readings

1. Schofield, A., & Wroth, P. (1968). *Critical state soil mechanics*(Vol. 310). London: McGraw-Hill.
2. Atkinson, J. (2017). *The mechanics of soils and foundations*. Boca Raton: CRC Press

GEOL - 6138 Engineering Geology II 3(2+1)

This course is a graduate course. One of the elective advance level courses in the group of specialization in Engineering Geology is Engineering Geology II. The courses will enable the students to fully understand (1) the rocks and soil mechanics and their role in construction industry, (2) the earthquake related seismicity and intensity, (3) the geological and geophysical surveys, (4) the infrastructure development and (5) the techniques for evaluation of building materials. (6) Hazard Zonation and assessment of rock masses using different techniques of empirical and analytical techniques. (7) Landslides and case studies of landslides. (8) Groundwater and characteristics of ground water. This special course also includes the project and special assignments. After completing these courses, the students will be able to carry out their independent research on the site development for construction.

Contents

1. Rock and soil mechanics and its application in civil engineering;
2. Study of geological factors in relation to the construction of buildings and foundations,
3. Roads, highways, excavation and tunneling, mine openings, dams and bridges;

4. Construction materials; slope stability analysis,
5. Hazard assessment, mass movement, their causes and prevention;
6. Application of geophysical methods for site investigation;
7. Construction in earth-quake zone; dams and their kinds geological investigations for selecting a site for a dam;
8. Landslides, classification, geometry, causes and preventive methods;
9. Ground water and character of ground water;
10. Case histories of important engineering projects (small and mega) in Pakistan.

Lab. Work
Special Assignments/Projects

Recommended Texts

1. Price, D. G. (2008). *Engineering geology: principles and practice*. London: Springer Science & Business Media.
2. Steffen, G. S., Candelaria, S. M., Stapledon, D., Bell, G., & Foster, M. (2014). *Geotechnical engineering of dams*. London: CRC press.

Suggested Readings

1. Bell, F. G. (2016). *Fundamentals of engineering geology*. Elsevier.
2. Beavis, F.C. (1985). *Engineering Geology*. Oxford: Blackwell Scientific.
3. Blyth, F. G. H., & De Freitas, M. (2017). *A geology for engineers*. London: CRC Press.

GEOL - 6140 Petroleum Engineering 3(2+1)

Petroleum engineering is a field of engineering concerned with the activities related to the production of hydrocarbons, which can be either crude oil or natural gas. Exploration and production are deemed to fall within the upstream sector of the oil and gas industry. Petroleum geologyand geophysics focus on provision of a static description of the hydrocarbon reservoir rock, while petroleum engineering focuses on estimation of the recoverable volume of this resource using a detailed understanding of the physical behavior of oil, water and gas within porous rock at very high pressure. The combined efforts of geologists and petroleum engineers throughout the life of a hydrocarbon accumulation determine the way in which a reservoir is developed and depleted, and usually they have the highest impact on field economics.

Contents

1. Introduction to rig components
2. drilling methods and operations
3. types of bits; drilling fluids
4. composition and function

5. cementation and casing operations
6. coring operations; mud and wireline logging
7. well testing and completion
8. well production operations
9. evaluation and analysis of well data i.e. well cutting, cores, logs and production data
10. secondary and enhanced oil recovery
11. common drilling problems and preventive measures
12. HSE at well site.

Lab. Work

Study of mass properties of rocks, wire line logs, cores, well cuttings, DSTand MDT pressure data.

Recommended Texts

1. Dobrin, M. B., & Savit, C. H. (2000). *Introduction to geophysical prospecting* (Vol. 4). New York: McGraw-hill.
2. Burger, H. R., Burger, D. C., & Burger, H. R. (1992). *Exploration geophysics of the shallow subsurface* (Vol. 8). Englewood Cliffs: Prentice Hall.

Suggested Readings

1. Bieniawski, Z. T. (2009). *Engineering rock mass classifications: a complete manual for engineers and geologists in mining, civil, and petroleum engineering*. New York: John Wiley & Sons.
2. Sereda, N.G., & Solvyon, E. M. (1998). *Drilling of Oil and Gas.* Wells Mir Publications.
3. Darling, T. (2005). *Well logging and formation evaluation*. Amsterdam: Elsevier.

GEOL - 6141 Reservoir Geology 3(2+1)

The main theme of this subject is to trains students to use modern measurement techniques, computational methods and new geological concepts to obtain a quantitative understanding of the processes behind reservoir rocks. These skills are useful not only in the petroleum industry but also in hydrogeology and other related branches and in the search for new energy sources. The Reservoir Geology courses meshes with the courses in petroleum Geology, petroleum engineering and geophysics. It will introduce the fundamental concepts Rock Fluid Interaction, properties of Hydrocarbon and oilfields fluids, reservoir sedimentology, exploration geology, production geology and advance seismic interpretation. It will also focus on the detail wire line log interpretation, reservoir characterization and development and its integration engineering. This course leads toward from the Conventional modeling workflow to conceptual geological models. These heterogeneities may be structural, stratigraphic, sedimentologic and/or diagenetic on origin, and often impact flow behavior and hydrocarbon recovery; hence, they must be captured in reservoir models.

Contents

1. Reservoir rock types: clastics, carbonates, and non-marine reservoirs.
2. Reservoir properties, depositional and diagenetic controls.
3. Fluid properties and their saturation.
4. Hydrocarbon distributing and fluid contacts.
5. Reservoir zonation and thickness mapping.
6. Reservoir pore spaces configuration.
7. Mapping reservoir heterogeneity.
8. Reservoir estimation and calculation of reservoir volumetric, material balance and production, decline curve methods.
9. Appraisal and development of reservoir basic concepts.
10. Petrophysical evaluation; Introduction to Reservoir Engineering.
11. Core analysis.
12. Well logs and well testing.

Recommended Texts

1. Bjorlykke, K. (2010). *Petroleum geoscience: From sedimentary environments to rock physics*. London: Springer Science & Business Media.
2. Asquith, G. B., Krygowski, D., & Gibson, C. R. (2004). *Basic well log analysis* (Vol. 16). Tulsa: American Association of Petroleum Geologists.

Suggested Readings

1. Ellis, D. V., & Singer, J. M. (2007). *Well logging for earth scientists* (Vol. 692). Dordrecht: Springer.
2. Gluyas, J., & Swarbrick, R. (2013). *Petroleum geoscience*. New York: John Wiley & Sons.
3. Bjorlykke, K. (2010). *Petroleum geoscience: From sedimentary environments to rock physics*. London: Springer Science & Business Media.

GEOL - 6142 Petroleum Geology of Pakistan 3(2+1)

Pakistan being a developing country is facing significant challenges of energy crises due to a deficit of hydrocarbons. So, it is essential to explore and develop new oil and gas fields with increasing drilling rate to meet energy requirements. So the course is designed to understand the basic knowledge about tectonics, depositional settings and lithostratigraphic divisions of the rocks of various geological periods in Pakistan as well as to learn about the evaluation of petroleum potentials of different basins. his course covers a wide range of earth science subjects and their application to the full spectrum of hydrocarbon exploration and production. This course is a one-year, full-time multidisciplinary programme covering a wide range of earth science subjects and their application to the full spectrum of hydrocarbon exploration and production. It is designed for students with some industrial experience, as well as for recent graduates seeking careers in the petroleum and allied service industries.

Contents

1. History of petroleum exploration

2. New trends for petroleum exploration
3. Tectonic framework
4. Sedimentary basins and their evolution and distribution
5. Sectonics, depositional settings and lithostratigraphic divisions of the rocks of various geological periods
6. Facies development and their association in depositional basins such as Indus, Baluchistan and offshore regions
7. Evaluation of petroleum potentials of different basins
8. Structural styles and petroleum play in the basins of Pakistan
9. Geothermal gradients and their maturity
10. Productive and potential oil and gas reservoirs and source rocks and their distribution in the basins
11. Play Fairways and Petroleum System in basins; case studies.

Lab. Work

Case histories of oil and gas fields of Pakistan.

Recommended Texts

1. Kadri, I. B. (1995). *Petroleum geology of Pakistan*. Karachi: Pakistan Petroleum Limited.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.

Suggested Readings

1. Bender, F., & Raza, H. A. (1995). *Geology of Pakistan.* Karachi: Oxford Press.
2. Haq, B. U., & Milliman, J. D. (1985). *Marine geology and oceanography of Arabian Sea and coastal Pakistan*. Karachi: Oxford University Press.

GEOL - 6149 Earthquake Seismology 3(2+1)

The course explores the processes that cause earthquakes, as well as the methodologies used by seismologists to analyze seismograms, to measure source parameters, and to simulate the seismic wave impact at the Earth's surface. The main goals are to provide an overview of earthquake seismology for non-seismologists, to introduce undergraduate geoscience students to earthquake seismology. The course is designed to deliver basic knowledge of earthquake phenomena. Describe the main scales for measuring the size of an earthquake. To enable undergraduate students to develop understanding for the occurrence of earthquakes according to elastic rebound theory and distribution of different types of earthquakes with reference to Plate Tectonic. Explain the relationship between earthquakes and faults and fault plan solutions. Learn basic techniques to locate earthquake epicenters using P and S waves.

Contents

1. Mathematical analysis of seismological processes on the basis of elastic wave theory
2. Seismic waves and their analysis in earthquake seismology
3. Frequency, magnitude, energy of an earthquake and their relationship
4. Source parameters and their determination
5. Composite fault plane solutions of earthquakes and their determination
6. Geographical distribution of important earthquakes
7. Earthquakes and their relationship to the tectonics of the area.

Lab. Work

Specified problems on data processing, analysis, fault solutions and interpretation.

Recommended Texts

1. Shearer, P. M. (2019). *Introduction to seismology*. Cambridge: Cambridge university press.
2. James, D. E. (Ed.). (1989). *Encyclopedia of solid Earth geophysics*. London: Springer Science & Business Media.

Suggested Readings

1. Borr, M. H. P. (1982). *The Interior of the Earth: its Structure, Constitution and Evolution.* London: Edward Arnold.
2. Shearer, P. M. (2019). Introduction to seismology. Cambridge: Cambridge University Press.
3. Bullen, K. E., Bullen, K. E., & Bolt, B. A. (1985). *An introduction to the theory of seismology*. Cambridge: Cambridge university press.

GEOL – 6151 Electrical and Radiometric Exploration Methods 3(2+1)

The major objective of this course is to skill undergraduate students with basic principles of the electrical and radiometric exploration methods used in mineral exploration and energy resources. Describe the different electrical and electromagnetic methods and how they relate to electrical conductivity and dielectric permittivity the importance of optimal processing and display of these data and the strengths and limitations of the various methods. Students shall learn how to extract the maximum amount of geological information from the data, recognizing noise-related artifacts in interpretation products and how to deal with the ambiguity when interpreting electrical and radiometric data sets. Core topics include the basic principles of the main geophysical exploration methods used in mineral exploration including the importance of optimal processing and display of these data and the strengths and limitations of the various methods. Particular attention is paid to extracting the maximum amount of geological information from the data, recognising noise-related artifacts in interpretation products and how to deal with the ambiguity when interpreting geophysical

datasets.

Contents

1. Fundamentals of current flow in the earth
2. Electrode arrangements and field procedures
3. Instruments; processing and interpretation of resistivity data
4. Field procedure, data acquisition and interpretation of self-potential
5. Induced polarization and electromagnetic methods;
6. Study of case histories.
7. Physical principles and basic theory of Radioactivity
8. Radioactivity of rocks
9. Radioactive dating methods
10. Field surveys and instruments for radiometric methods
11. Data processing and interpretation of radiometric surveys
12. Application of radiometric methods in exploration of minerals and energy resources

Recommended Texts

1. Dobrin, M. B., & Savit, C. H. (2000). *Introduction to geophysical prospecting* (Vol. 4). New York: McGraw-hill.
2. Nabighian, M. N. (Ed.). (1991). *Electromagnetic Methods in Applied Geophysics*. Volume 2, Application, Parts A and B. Amsterdam: Society of Exploration Geophysicists.

Suggested Readings

1. Kearey, P., Brooks, M., & Hill, I. (2013). *An introduction to geophysical exploration*. New York: John Wiley & Sons.
2. Robinson, E. S. and Coruh, C. (1988) *Basic Exploration Geophysics.* New York: John Wiley & Sons.

GEOL - 6153 Seismic Prospecting 3(2+1)

The overall objective of this course is to introduce undergraduate students to seismic data acquisition, technical processing concepts and interpretation principles that form the basis for value added seismic applications in exploration of hydrocarbon and reservoir management. This course will provide practical understanding of seismic acquisition, processing and interpretation skill. Data examples and practical exercises will illustrate key concepts, practical issues, and pitfalls of acquisition and processing as they affect the interpretation of seismic data. The students will be introduced to seismic data interpretation to generate structural and stratigraphic sections using seismic and well data. The participant learns to answer these and related questions by gaining an understanding of the seismic system, its limitations and pitfalls, and by interpreting 2D and 3D seismic examples of structural and stratigraphic features associated with actively producing hydrocarbon areas.

Contents

1. Planning for 2D and 3D seismic surveys and concepts of recording parameters
2. Types of seismic surveys
3. Onshore and offshore seismic surveys
4. Methodology of seismic data acquisition
5. Seismic equipment
6. Types of seismic energy sources and recording equipment
7. Acquisition methods,
8. Quality control of data during acquisition and processing
9. Field processing,
10. Work flow for various basic and advanced processing techniques
11. Seismic mapping and interpretation of 2D and 3D seismic data
12. Well seismic (VSP)
13. Forward seismic Modeling
14. Ray tracing
15. Synthetic seismograms generation
16. AVO for lithology and DHI
17. Applications in Exploration and Production.

Recommended Texts

1. Burger, H. R., Burger, D. C., & Burger, H. R. (1992). *Exploration geophysics of the shallow subsurface* (Vol. 8). Englewood Cliffs: Prentice Hall.
2. Mares, S., & Tvrdý, M. (1984). *Introduction to applied geophysics*. London: Springer Science & Business Media.

Suggested Readings

1. Pal, S. K. (1998). *Statistics for Geoscientists Techniques and Applications*. Delhi: Concept Publishing Company.
2. Davis, J. C., & Sampson, R. J. (1986). *Statistics and data analysis in geology* (Vol. 646). New York: John Wiley & Sons.
3. Freeden, W., Nashed, M. Z., & Sonar, T. (Eds.). (2010). *Handbook of geomathematics*. London: Springer Science & Business Media.

BS
GEOGRAPHY

GEOG- 5101 Fundamentals of Geography 3(3+0)

This course is graduate-level course to expose students with the founding principles of Geography and geographical knowledge. A systematic descriptive introduction to the diverse elements of landscape including geomorphic, climatic, and biotic elements, human settlement and land-use patterns; cartographic approaches to the analysis of selected processes of landscape change. This course provides an opportunity for understanding part of the complex physical and biological environment in which human beings live.The nature and processes of geo-system and its constituent parts: atmosphere, lithosphere, hydrosphere and biosphere; structure and composition of the atmosphere: atmospheric circulation, weather and climate, energy transmission, spatial variation of energy inputs and energy budget; structure and composition of the earth: tectonics and related processes; hydrological cycle and its components: precipitation, evapotranspiration, groundwater, surface water and the oceans; vegetation zones of the world: world soils, ecosystems, biomes, energy and matter flows.

Contents

1. Introduction, Definitions, scope and branches of Geography
2. Roots of the discipline and basic geographic concepts
3. Themes and traditions of Geography
4. Tools of Geography, The Universe, Galaxies and solar system
5. The Earth as a planet, Celestial positions, its shape and size
6. Rotation, revolution and related phenomena
7. Spheres of the earth, Lithosphere, Atmosphere, Hydrosphere
8. Biosphere
9. Man-environment interaction
10. Population
11. Major Economic activities
12. Settlements
13. Pollution

Lab. Work

1. Comprehension of atlases
2. Map reading skills, location of places
3. Features and relevant work related to topics of the theoretical section.

Recommended Texts

1. Arbogast, A. F. (2007). *Discovering physical geography*. London: John Wiley and Sons.
2. Christopherson, R. W. (2009). *Geo systems: an introduction to physical geography*. New Jersey: Pearson Prentice Hall.

Suggested Readings

1. De Blij, H. J and Muller, P. O. (1996). *Physical geography of the global environment*. London: John Wiley and Sons.
2. Strahler, A. (2013). *Introduction to physical geography*. New Jersey: John Wiley & Sons.

URCM – 5107 **Mathematics I** **3(3+0)**

The goal of Mathematics I is to prepare students for first-year Calculus. Helping students gain proficiency in their understanding and ability to utilize real-valued functions, the primary tool in Calculus, accomplishes this goal. Students are presented a broad set of 'function tools', including a general understanding of function properties together with a 'library' of commonly used functions. It is intended that students become skilled at recognizing the different families of functions and the primary properties that set each apart, are able to apply the general function properties to each type of function, and are able to use the special set of algebraic skills associated with each. Students are also expected to become adept in utilizing and interpreting the results from graphing calculators, as an important investigative tool.

Contents

1. Preliminaries
2. Real-number system
3. complex numbers
4. Introduction to sets, set operations, functions, types of functions.
5. MatricesIntroduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.
6. Quadratic Equations
7. Solution of quadratic equations, qualitative analysis of roots of a quadratic
8. equations
9. Equations reducible to quadratic equations
10. Cube roots of unity, relation between roots and coefficients of quadratic
11. Equations
12. Sequences and Series
13. Arithmetic progression
14. Geometric progression
15. Harmonic progression
16. Binomial Theorem
17. Introduction to mathematical induction
18. Binomial theorem with rational and irrational indices.
19. Trigonometry
20. Fundamentals of trigonometry
21. Trigonometric identities.

Recommended Texts

1. Thomas, G. B., & Finney, A. R. *(2005). Calculus.* Reading: Addison-Wesley.
2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley.

Suggested Readings

1. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole.
2. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company.

3. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.). Reading: Addison-Wesley.

URCE-5101 Grammar 3(3+0)

The course introduces the students to the underlying rules to acquire and use language in academic context. The course aims at developing grammatical competence of the learners to use grammatical structures in context in order to make the experience of learning English more meaningful enabling the students to meet their real life communication needs. The objectives of the course are to, reinforce the basics of grammar, understand the basic meaningful units of language, and introduce the functional aspects of grammatical categories and to comprehend language use by practically working on the grammatical aspects of language in academic settings. After studying the course, students would be able to use the language efficiently in academic and real life situations and integrate the basic language skills in speaking and writing. The students would be able to work in a competitive environment at higher education level to cater with the long term learners' needs.

Contents

1. Parts of speech
2. Noun and its types
3. Pronoun and its types
4. Adjective and its types
5. Verb and its types
6. Adverb and its types
7. Prepositions and its types
8. Conjunction and its types
9. Phrases and its different types
10. Clauses and its different types
11. Sentence, parts of sentence and types of sentence
12. Synthesis of sentence

Recommended Texts

1. Eastwood, J. (2011). *A basic English grammar*. Oxford: Oxford University Press.
2. Swan, M. (2018). *Practical English usage* (8th ed.). Oxford: Oxford University Press.

Suggested Readings

1. Thomson, A. J., & Martinet, A. V. (1986). *A practical English grammar*. Oxford: Oxford University Press
2. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.
3. Hunston, S., & Francis, G. (2000). *Pattern grammar: A corpus-driven approach to the lexicalgrammar of English*. Amsterdam: John Benjamins.

URCI-5105 **Islamic Studies** **2(2+0)**

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'an and Sunnah.Islamic Studies is the academic study of Islam and Islamic culture. It majorly comprises of the importance of life and that after death. It is one of the best systems of education, which makes an ethical groomed person with the qualities which he/she should have as a human being. The basic sources of the Islamic Studies are the Holy Qur'an and Sunnah or Hadith of the Holy Prophet Muhammadﷺ. The learning of the Qur'an and Sunnah guides the Muslims to live peacefully.

Contents

1. Study of the Qur'an (Introduction to the Qur'an, Selected verses from *Surah Al-Baqarah, Al-Furqan, Al-Ahzab, Al-Mu'minoon, Al-An'am, Al-Hujurat, Al-Saff*)
2. Study of the Hadith (Introduction to Hadith literature, Selected Ahadith (Text and Translation)
3. Introduction to Qur'anic Studies
4. Basic Concepts of Qur'an
5. History of Quran
6. Basic Concepts of Hadith
7. History of Hadith
8. Kinds of Hadith
9. Uloom –ul-Hadith
10. Sunnah& Hadith
11. Seeratul-Nabi (PBUH), necessity and importance of Seerat, role of Seerah in the development of personality, Pact of Madinah, KhutbahHajjat al-Wada' and ethical teachings of Prophet (PBUH).
12. Legal Position of Sunnah
13. Islamic Culture & Civilization
14. Characteristics of Islamic Culture & Civilization
15. Historical Development of Islamic Culture & Civilization
16. Comparative Religions and Contemporary Issues
17. Impact of Islamic civilization

Recommend Texts

1. Hassan, A. (1990). *Principles of Islamic jurisprudence*. New Dehli: Adam Publishers.
2. Zia-ul-Haq, M. (2001). *Introduction to al-Sharia al-Islamia*. Lahore: Aziz Publication.

Suggested Readings

1. Hameedullah, M. (1957). *Introduction to Islam*. Lahore: Sh M Ashraf Publisher.
2. Hameedullah, M. (1980). *Emergence of Islam*. New Dehli: Adam Publishers.

3. Hameedullah, M. (1942). *Muslim conduct of state.* Lahore: Sh M Ashraf Publisher.

GEOL –5101 Introduction to Geology 3(3+0)

This course is designed to acquire the knowledge about the basic concepts of geology. This will help the students to get knowledge about various types of rocks, minerals and the processes of their formation. Geology is the core discipline of the earth sciences and encompasses many different phenomena, including plate tectonics and mountain building, volcanoes and earthquakes, and the long-term evolution of Earth's atmosphere, surface and life. The goal of the Geology undergraduate program is to equip students with the fundamental knowledge of the diverse fields of Geology (encompassing Geomorphology & Surface Processes, Hydrology & Low-Temperature Geochemistry, Sedimentology & Paleoecology, and Tectonics and Solid-Earth Processes). In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. It helps to know the geologic time scale and place important geologic events in a temporal framework. Identify and interpret common fossils, common rock-forming minerals and rock-forming processes, Interpret environments of deposition of sedimentary rocks, Identify common rocks and interpret them with respect to tectonics.

Contents

1. Introduction and scope of geology; importance and relationship with other sciences
2. History and philosophy of geology; Earth as a member of the solar system
3. Earth's origin, age, composition and internal structure
4. Introduction to plate tectonics, Isostasy; mountain building processes
5. Earthquakes and volcanoes; weathering and erosion
6. Introduction, identification and classification of rocks and minerals
7. Sedimentary, igneous and metamorphic structures
8. Introduction to fossils in sedimentary rocks
9. Introduction to folds, faults, joints, cleavage, foliation, lineation and unconformities
10. Geological Time Scale; Law of Superposition, present is key to the past and Law of Faunal Succession
11. Concept and techniques of geological dating, relative and absolute dating; evolution of life on earth
12. Use of Brunton Compass and GPS, etc.

Recommended Texts

1. Plummer, (2012).*Physical geology*. (14th Ed.). New York: McGraw-Hill.

Suggested Readings

1. Smith, G., & Pun, A. (2013). *How does earth work? physical geology and the process of Science.* London: Pearson.
2. McClay, K. R. (2013). *The mapping of geological structures*. Hoboken: John Wiley & Sons.

ENVR -5101 Introduction to Environmental Sciences 3(3+0)

This course is designed to acquire the knowledge about the role of the environmental science in our daily life. This will help the students to learn how the various environmental processes and related human activities are involved in contaminating our ecosystem. Acquire an awareness of the environment as a whole and its related problems. Gain a variety of experiences and acquire a basic understanding and knowledge about the environment and its allied problems. Acquire an attitude of concern for the environment. Acquire the skills for identifying and solving environmental problems. Participate in improvement and protection of environment. Develop the ability to evaluate measures for the improvement and protection of environment. Environmental studies are to develop a world in which persons are aware of and concerned about environment and the problems associated with it, and committed to work individually as well as collectively towards solutions of current problems and prevention of future problems.

Contents

1. Basic concepts like Introduction, History and Nature.
2. Scope of Environmental Science and its contribution to society.
3. Principles of natural resources.
4. Different aspects of environment: Physical, Ecological, Socio-Economic, Ethical
5. Global warming and Greenhouse effect.
6. Impact of acidic rain on an environment.
7. Major components of environment: Physico-Chemical, Biological and Social,
8. Relationships with various environmental factors.
9. Human environment and its problems: Global, National.
10. Human environment and its Regional.
11. Environmental challenges: Current and Future trends in population growth.
12. Environmental challenges for sustainable development
13. Urbanization, Poverty and Resource depletion.
14. Environmental Pollution, Development in industry and agriculture.

Recommended Texts

1. Botkin, D. B & Keller, E.A, (2007). *Environmental science: earth as a living planet*. Hoboken: John Wiley & Sons.
2. McKinney, M. L., Schoch, R.M. & Yonavjak, L. (2007). *Environmental Science: systems and solutions*. Burlington: Jones & Bartlett Publishers.

Suggested Readings

1. Wright, R.T. & Nebel, B.J, (2007). *Environmental science: toward a sustainable future*. London: Pearson Educational.
2. Miller, G., Thomson, L. (2002). *Environmental science: working with the earth.* Hoboken: John Wiley & Sons.

GEOG - 5102 Physical Geography 3(3+0)

This course provides an opportunity for understanding part of the complex physical and biological environment in which human beings live. It introduces basic processes that influence the characteristics and spatial relationships of climate, water cycle and vegetation. The first part of the course examines the interactions of solar energy with the Earth's atmosphere and surface, and how atmospheric circulation, precipitation, and weather systems are generated. The second part of the course covers the cycling of water and other Earth resources within the living zone - the biosphere. It focuses on how these cycles, together with the flows of energy, influence the nature and distribution of ecosystems and vegetation. Throughout the course, students look at patterns of human activity that are in response to and have an effect upon environmental processes, and are asked to observe and interpret aspects of their local environment in light of what they have learned.

Contents

1. Definition, scope and major branches
2. Realms of the physical environment
3. Lithosphere
4. Internal structure of earth
5. Rocks–origin, formation and types: Igneous, Sedimentary and Metamorphic Rocks
6. Plate tectonics, mountain building forces.
7. Geomorphic processes – endogenic and exogenic processes and their resultant landforms
8. Earthquakes and volcanic activity, folding and faulting
9. Weathering, mass wasting, cycle of erosion, erosion and deposition
10. Landforms produced by running water, ground water, wind and glaciers
11. Atmosphere
12. Composition and structure of atmosphere
13. Atmospheric temperature and pressure, global circulation
14. Atmospheric moisture and precipitation
15. Air masses and fronts
16. Cyclones and other disturbances
17. Hydrosphere
18. Hydrological cycle
19. Ocean composition, temperature and salinity of ocean water
20. Movements of the ocean water; waves, currents and tides
21. Biosphere

Recommended Texts

1. Strahler, A. (2013). *Introduction to physical geography*. New York: John Wiley & Sons.
2. Thornbury, W. D. (2004). *Principles of geomorphology*. New Jersey: John Willy &Sons.

Suggested Readings

1. Strahlar, A. N., & Strahlar, A. H. (2004). *Physical environment*. New York: John Wiley & Sons.

2. Stringer, E. T. (2004). *Modern physical geography*. New York: John Wiley & Sons.

URCE-5102 Language Comprehension & Presentation Skills 3(3+0)

The course aims at developing linguistic competence by focusing on basic language skills in integration to make the use of language in context. It also aims at developing students' skills in reading and reading comprehension of written texts in various contexts. The course also provides assistance in developing students' vocabulary building skills as well as their critical thinking skills. The contents of the course are designed on the basis of these language skills: listening skills, pronunciation skills, comprehension skills and presentation skills. The course provides practice in accurate pronunciation, stress and intonation patterns and critical listening skills for different contexts. The students require a grasp of English language to comprehend texts as organic whole, to interact with reasonable ease in structured situations, and to comprehend and construct academic discourse. The course objectives are to enhance students' language skill management capacity, to comprehend text(s) in context, to respond to language in context, and to write structured response(s).

Contents

1 Listening skills
2 Listening to isolated sentences and speech extracts
3 Managing listening and overcoming barriers to listening
4 Expressing opinions (debating current events) and oral synthesis of thoughts and ideas
5 Pronunciation skills
6 Recognizing phonemes, phonemic symbols and syllables, pronouncing words correctly
7 Understanding and practicing stress patterns and intonation patterns in simple sentences
8 Comprehension skills
9 Reading strategies, summarizing, sequencing, inferencing, comparing and contrasting
10 Drawing conclusions, self-questioning, problem-solving, relating background knowledge
11 Distinguishing between fact and opinion, finding the main idea, and supporting details
12 Text organizational patterns, investigating implied ideas, purpose and tone of the text
13 Critical reading, SQ3R method
14 Presentation skills, features of good presentations, different types of presentations
15 Different patterns of introducing a presentation, organizing arguments in a presentation
16 Tactics of maintaining interest of the audience, dealing with the questions of audience
17 Concluding a presentation, giving suggestions and recommendations

Recommended Texts

1 Mikulecky, B. S., & Jeffries, L. (2007). *Advanced reading power: Extensive reading, vocabulary building, comprehension skills, reading faster*. New York: Pearson.
2 Helgesen, M., & Brown, S. (2004). *Active listening: Building skills for understanding*. Cambridge: Cambridge University Press.

Suggested Readings

1 Roach, C. A., & Wyatt, N. (1988). *Successful listening*. New York: Harper & Row.
2 Horowitz, R., & Samuels, S. J. (1987). *Comprehending oral and written language*. San Diego: Academic Press.

URCP-5106 **Pakistan Studies** **2(2+0)**

The course is designed to acquaint the students of BS Programs with the rationale of the creation of Pakistan. The students would be apprised of the emergence, growth and development of Muslim nationalism in South Asia and the struggle for freedom, which eventually led to the establishment of Pakistan. While highlighting the main objectives of national life, the course explains further the socio-economic, political and cultural aspects of Pakistan's endeavours to develop and progress in the contemporary world. For this purpose, the foreign policy objectives and Pakistan's foreign relations with neighbouring and other countries are also included. This curriculum has been developed to help students analyse the socio-political problems of Pakistan while highlighting various phases of its history before and after the partition and to develop a vision in them to become knowledgeable citizens of their homeland.

Contents

1. Contextualizing Pakistan Studies
2. Geography of Pakistan: Geo-Strategic Importance of Pakistan
3. Freedom Movement (1857-1947)
4. Pakistan Movement (1940-47)
5. Muslim Nationalism in South Asia
6. Two Nations Theory
7. Ideology of Pakistan
8. Initial Problems of Pakistan
9. Political and Constitutional Developments in Pakistan
10. Economy of Pakistan: Problems and Prospects
11. Society and Culture of Pakistan
12. Foreign Policy Objectives of Pakistan and Diplomatic Relations
13. Current and Contemporary Issues of Pakistan
14. Human Rights: Issues of Human Rights in Pakistan

Recommended Texts

1. Kazimi, M. R. (2007). *Pakistan studies.* Karachi: Oxford University Press.
2. Sheikh, J. A. (2004). *Pakistan's political economic and diplomatic dynamics.* Lahore: Kitabistan Paper Products.

Suggested Readings

1. Hayat, S. (2016). *Aspects of Pakistan movement.* Islamabad: National Institute of Historical and Cultural Research.
2. Kazimi, M. R. (2009). *A concise history of Pakistan.* Karachi: Oxford University Press.
3. Talbot, Ian (1998). *Pakistan: a modern history*. London: Hurst and Company.

ULAW-5130 Introduction to Basic Laws 3(3+0)

This course is designed to educate the students at large, the law, rules, regulations related to daily life. Students should behave and ensure order, predictability and security in some basic fields of life. This course is designed to aware the basic rights and obligations to make the civic. This course will develop basic necessary knowledge, skills and attitude for legal awareness among the students. to enlighten the basic principles and rules regarding basic Fundamental rights of citizens as give by The Constitution of Islamic Republic of Pakistan, Human Rights Laws, Consumer Protection Laws, Environmental Laws and Women Protection Laws in order to gain insight into law and legal system. It will provide basic acquaintance to legal principles and will advance the social justice. Moreover, it will impart light on corners of life that will make the student more vibrant, civilized and law abiding citizens.

Contents

1. The Constitution of Islamic Republic of Pakistan, 1973
2. Fundamental Rights Article 8 to 28
3. Framework for implementation of Fundamental Rights under Article 184 and 199
4. European Convention on Human Rights
5. Universal Declaration of Human Rights 1948
6. Theory and practice of Human Rights in Pakistan
7. The Punjab Consumer Protection Act, 2005
8. The Punjab Consumer Protection Rules, 2009
9. Environmental Laws
10. The Pakistan Environmental Protection Act, 1997
11. The Punjab Environmental Protection Act, 1997
12. Women Protection Laws The Women Protection Act, 2006
13. The Protection Against Harassment of Women at Workplace Act, 2010

Recommended Texts

1. Emanuel, S. L. (2019). *Constitutional law.* New York: Wolters Kluwer.
2. Adil, Z. H. (2014). *The manual of consumer protection laws in Pakistan*. Lahore: Kashif Law Book House.

Suggested Readings

1. Brownlie, I., & Goodwin-Gill, G. S. (Eds.). (2010). *Brownile's documents on human rights*. London: Oxford University Press.
2. Salzman, J., & Thompson, B. H. (2003). *Environmental law and policy.* New York: Foundation Press.
3. *The Protection Against Harassment of Women at Workplace Act,2010* (As amended up to date)

ENVR – 5104 Environmental Geology 3(3+0)

This course is designed to acquire the knowledge about the role of geology in the environmental degradation. As a discipline, environmental geology deals with using geological knowledge to address interactions between humans and the physical environment: the biosphere, the lithosphere, the hydrosphere, and, to some degree, the atmosphere. Environmental geology is a multidisciplinary subject that covers a broad range of topics, ranging from Earth materials and their use to Earth processes, including natural hazards and their impact on human lives. The environmental effects of exploring Earth resources is also an integral component of the course. This will help the students to learn how the various geological processes and related human activities are involved in contaminating our ecosystem. managing geological and hydrogeological resources such as fossil fuels, minerals, water (surface and ground_water), and land_use. Studying the earth's surface through the disciplines of geomorphology, and defining and mitigating exposure of natural hazards on humans managing industrial and domestic waste disposal and minimizing or eliminating effects of pollution, and performing associated activities, often involving litigation.

Contents

1. Introduction to environmental geology.
2. Management of natural resources.
3. Air pollution and global climatic changes.
4. Environmental controls for erosion, desertification and coastal degradation.
5. Geological hazards such as floods, landslides and earthquakes.
6. Volcanoes, glaciers and shoreline processes, their remedial measures.
7. Environmental impact of mining, dams, reservoirs, highways, their assessment and controls.
8. Cleaner sources of energy.
9. Industrial pollution, waste disposal,
10. Groundwater contaminations, River Lake and marine pollution and their impact on human health.
11. Geological aspects of human health.
12. Trace elements and health hazards.

Lab. Work

1. Sampling and analysis of air, water, soil and rocks.

Recommended Texts

1. Keller, E.A., Chales E. (1990). .*Environmental geology*. Paris: Merril Publishing Co.
2. Mazore, E. (2000). *Applied Chemical Groundwater Hydrology*. New York: McGraw Hill.

Suggested Readings

1. Merritts, D., De Wet, A., & Menking, K. (2000). *Environmental Geology: an earth system science approach*. New York: Macmillan.

2. Montgomery, C.W. (2005). .*Environmental geology*. New York: McGraw Hill.

INTR-5101 Introduction to International Relations 3(3+0)

The study and practice of international relations is interdisciplinary in nature, blending the fields of economics, history, and political science to examine the topics such as human rights, global poverty, the environment, economics, globalization, security, global ethics, and the political environment. Historically, the establishment of treaties between nations served as the earliest form of international relations. International relations allows nations to cooperate with one another, pool resources, and share information as a way to face global issues that go beyond any particular country or region.This course provides a comprehensive introduction to international relations, focusing in particular on its origins and historical evolution, its key concepts, major theoretical frameworks, main actors and institutions, the global architecture of power, and its dynamic nature in the process of globalization. More specifically, this course introduces concepts of power, statecraft, diplomacy, foreign policy, political economy and international security, and examines the evolution of international relations as a subject.

Contents

1. IR as an Academic Field
2. Realism, Liberalism, Marxism, Social Constructivism
3. Relevance to Current Issues
4. US, Russia and Rise of China
5. Development of the International System
6. History of state development (City State to Empires)
7. Westphalia and Emergence of State system
8. Industrial Revolution and French Revolution
9. World War I & World War II
10. Cold War and Post-Cold War
11. States and Other Actors
12. Sovereignty and Nationalism
13. States, IGOs, TNAs
14. Globalization
15. Foreign Policy
16. Diplomacy
17. International Institutions, United Nations, Security Council, General Assembly
18. UN Agencies, World Bank / IMF
19. Regional organizations: NATO, ASEAN and SAARC etc.

Recommended Texts

1. Devetak, R., George, J., & Percy, S. (2017). *An iintroduction to iinternational relations.* Cambridge: Cambridge University Press.
2. Baylis, J., Smith, S., & Owens, P. (2004). *The globalization of world politics*. London: Oxford University Press.

Suggested Readings

1. Jackson, R. and Sørensen, G.(2016). *Introduction to internationalrelations.* London: Oxford University Press.
2. Carlsnaes, W., Carlsnaes, W., Risse-Kappen, T., & Simmons, B. (2013). *Handbook of international relations.* London: SAGE Publications.

GEOG– 5103 Human Geography 3(3+0)

This course provides an introduction to Human Geography. The major thrust is on the study of human societies in their relation to the habitat or environment. Dealing with the spatial distribution of societies, human geography covers a very wide field or its scope is enormous. It embraces the study of human races; the growth, distribution and density of populations of the various parts of the world, their demographic attributes and migration patterns; and physical and cultural differences between human groups and economic activities. It also covers the relationship between man and his natural environment, and the way in which his activities are distributed. Human geography also takes into account the mosaic of culture, language, religion, customs and traditions; types and patterns of rural settlements, the site, size, growth and functions of urban settlements, and the functional classification of towns. The study of spatial distribution of economic activities, industries, trade, and modes of transportations and communications as influenced by the physical environment are also the important topics of human geography.

Contents

1. Introduction
2. Definition, scope and branches
3. Basic approaches
4. Population and its characteristics and population distribution
5. Population structure and composition
6. Population dynamics (fertility, mortality, migration etc.)
7. Economic activities
8. Agriculture, mining, forestry, animal husbandry and poultry
9. Industries: cottage, light and heavy
10. Trade, transport and services
11. Tourism
12. Settlements
13. Theories of human settlement
14. Types of settlements

Recommended Texts

1. Ahmed, Q. S. (2001). *Fundamentals of human geography*. Karachi: Royal Book Company.
2. Becker, A. & Secker. (2002). *Human geography: culture, society, and space.* , New Jersey: John Wiley and Sons.

Suggested Readings

1. Benko, G. & Shorhmay. (2004). *Human geography: a history for the 21st century.* London: Hodder Arnold.

2. Blij, H. J. D. (2002).*Human geography: culture, society, and space.* New Jersey. John Wiley and Sons.
3. Cloke, P. & Crang, P. (2005). *Introducing human geographies*, (2nd ed.). London: Hodder Arnold.

URCE-5103 Academic Writing 3(3+0)

Academic writing is a formal, structured and sophisticated writing to fulfill the requirements for a particular field of study. The course aims at providing understanding of writer's goal of writing (i.e. clear, organized and effective content) and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to the content logically to add specific details on the topics such as facts, examples and statistical or numerical values. The course will also provide insight to convey the knowledge and ideas in objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents

1. Academic vocabulary
2. Quoting, summarizing and paraphrasing texts
3. Process of academic writing
4. Developing argument
5. Rhetoric: persuasion and identification
6. Elements of rhetoric: Text, author, audience, purposes, setting
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Paragraph and essay writing
10. Organization and structure of paragraph and essay
11. Logical reasoning
12. Transitional devices (word, phrase and expressions)
13. Development of ideas in writing
14. Styles of documentation (MLA and APA)
15. In-text citations
16. Plagiarism and strategies for avoiding it

Recommended Texts

1. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
2. Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.

Suggested Readings

1. Craswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

URCS-5108 Introduction to Statistics 3(3+0)

This course is designed for under-graduate level. Statistical analysis is a basic requirement in order to analyze the phenomenon related to all sectors. This course aims to produce skills related to descriptive as well as inferential statistical analysis. Use of descriptive, inferential, regression, sampling statistics has vital importance to analyze and decision making theories related to agriculture, economics and business statistics etc.

Contents

1. Introduction to Statistics: Descriptive and Inferential Statistics,
2. Limitations of Statistics
3. Scope of Statistics
4. Variable, Data, Types of Variable and Data, Scales of Measurements.
5. Display of Data: Tabulation of Data, Graphical Display, Histogram, Bar Charts, Pie Chart,
6. Stem and Leaf Plots.
7. Measures of Central Tendency: Mean Median, Mode, Box Plot, and Application in Real Life.
8. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance and Standard
9. Deviation, Coefficient of Variation, Z-score and their Application.
10. Normal Distribution: Normal Distribution and its Application,
11. Sampling and Sampling Distribution.
12. Estimation:
13. Hypothesis Testing
14. Regression and Regression Analysis: Simple Linear Regression, Multiple Regression, Fitness
15. Model.
16. All the observational analysis will be carried out using MS Excel and SPSS.

Recommended Texts

1. Chaudhry, S. M. & Kamal, S. (2010). *Introduction to statistical theory*. (Parts I &II). Lahore: Ilmi Kitab Khana.
2. Walpole, R. E., Mysters, R. H. & Myers, S. L. (1998). *Probability and statistics for engineers and scientists*. New York: Prentice Hall.

Suggested Readings

1. Mclave, J. T., Benson, P. G. & Snitch. (2005). *Statistics for business & economics*. New Jersey: Prentice Hall.
2. Spiegel, M. R., Schiller, J. L. & Sirinivasan, R. L. (2000) *Probability and statistics*. New York: McGraw Hill
3. Clark, G. M., & Cooke, D. (1998). *Basic course in statistics*. London: Arnold.
4. Weiss, N. A. (1997). *Introductory Statistics*. Boston: Addison-Wesley.

SOCI-5101 General Sociology-I 3 (3+0)

Sociology is the study of society, patterns of social relationships, social interaction, and culture that surrounds everyday life It is a social science that uses various methods of empirical investigation and critical analysis to develop a body of knowledge about social order and social change. Subject matter can range from micro-level analyses of society to macro-level analyses .The course is designed to introduce the students with basic sociological concepts and to get familiarity with the overall discipline. The focus of the course shall be on basic concepts like scope and significance of Sociology, How Sociology is related as well as distinct from other social sciences. It focuses on the constituent parts of the society i.e. social systems and structures, socio-economic changes and social processes. This will also give an understanding of the Culture, elements of culture and the relationship of culture and personalities. The course will provide due foundation for further studies in the field of sociology.

Contents

1 Introduction to Sociology: The Science of Society, Scope and significance
2 Fields of Sociology: Sociology and other Social Sciences
3 Social interaction and social structure: The Nature and Basis of Social Interaction
4 Social Processes: Social structure Status, Roles, Power and Authority, Role Allocation
5 Culture: Meaning and nature of culture, Elements of culture: Norms, values beliefs, sanctions
6 Culture and Socialization, Transmission of Culture, Cultural Lag, Cultural Variation
7 Cultural Integration, Cultural Evolution, Cultural Pluralism, Culture and personality
8 Socialization & personality: Socialization, Agents of socialization
9 Personality: components of personality
10 Deviance and social control: Deviance and conformity
11 Mechanism and techniques of social control, Agencies of social control
12 Social organization: Definition, meaning and forms, Social groups; Functions of groups
13 Social Institutions: forms, nature and inter-relationship
14 Community: definition and forms (Urban and rural).
15 Social Institutions: Structure and functions of Institutions
16 Family, Religion, Education, Economy and political institution

Recommended Texts

1 Giddens, A., & Sutton, P. W. (2018). *Sociology* (11thed), Cambridge: Polity Press.
2 Macionis, J. J. (2016). *Sociology*. New Jersey: Prentice-Hall

Suggested Readings

1 Andersen, M., & Taylor, H. (2012). *Sociology: the essentials*. Toronto: Nelson Education.
2 Richard, T. S. (2012). *Sociology.* New York. McGraw Hill.
3 Henslin, J. M. (2011). *Sociology: A Down to Earth Approach, Census Update*. Upper Saddle River: Prentice Hall.

URCI-5109 Introduction to Information & Communication Technologies 3(3+0)

The course introduces students to information and communication technologies and their current applications in their respective areas. Objectives include basic understanding of computer software, hardware, and associated technologies. They can make use of technology to get maximum benefit related to their study domain. Students can learn how the Information and Communications systems can improve their work ability and productivity. How Internet technologies, E-Commerce applications and Mobile Computing can influence the businesses and workplace. At the end of semester students will get basic understanding of Computer Systems, Storage Devices, Operating systems, E-commerce , Data Networks, Databases, and associated technologies. They will also learn Microsoft Office tools that includes Word, Power Point, Excel. They will also learn Open office being used on other operating systems and platforms. Specific software's related to specialization areas are also part of course. Course will also cover Computer Ethics and related Social media norms and cyber laws.

Contents

1. Introduction, Overview and its types.
2. Hardware: Computer Systems & Components, Storage Devices and Cloud Computing.
3. Software: Operating Systems, Programming and Application Software,
4. Introduction to Programming Language
5. Databases and Information Systems Networks
6. The Hierarchy of Data and Maintaining Data,
7. File Processing Versus Database Management Systems
8. Data Communication and Networks.
9. Physical Transmission Media & Wireless Transmission Media
10. Applications of smart phone and usage
11. The Internet, Browsers and Search Engines.
12. Websites Concepts, Mobile Computing and their applications.
13. Collaborative Computing and Social Networking
14. E-Commerce & Applications.
15. IT Security and other issues

Recommended Texts

1. Vermaat, M. E. (2018). *Discovering computers: digital technology, data and devices.* Boston: Course Technology Press.

Suggested Readings

1. Timothy J. O'Leary & Linda I. (2017). *Computing essentials*, (26th ed.). San Francisco: McGraw Hill.
2. Schneider, G. M., &Gersting, J. (2018). *Invitation to computer science*. Boston: Cengage Learning.

GEOG -5104 Map Work 3(2+1)

A unique aspect of geography is that it exposes students to a wide range of techniques for helping to understand human and environmental patterns and processes. Mapmaking is the study and practice of making representations of the Earth on a flat surface. Viewed in the broadest sense, this process includes everything from the gathering, evaluation and processing of source data, through the intellectual and graphical design of the map, to the drawing and reproduction of the final document. As such, it is a unique mixture of science, art and technology and calls for a variety of in-depth knowledge and skills on the part of the cartographer.

Contents

1. Maps
2. Elements and types
3. Principles and methods of map making
4. Reading and reproduction
5. Scale: types and their use
6. Grid reference and indexation,
7. Map projections
8. Cylindrical
9. Conical
10. Zenithal
11. Construction, characteristics, and uses
12. Enlargement and reduction of maps
13. A study of the Survey of Pakistan maps
14. Physical and cultural features to be described and interpreted
15. Interpretation of weather maps of Pakistan

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. New Delhi: Vikas Publishing House Pvt. Ltd.
2. Singh, L. & Raghu, N. S. (2000) *Map work and practical geography*. New Delhi: Kalyani publishers.

Suggested Readings

1. Khan, M. Z. A. (1998). *Text Book of Practical Geography*. Delhi: Concept Publishing Company.

2. Bygott, J. (1952). *An introduction to mapwork and practical geography*. London: University Tutorial Press.
3. Bygott, J. (1955). *Mapwork and practical geography*. London: University Tutorial Press.

GEOG - 5105 History and Development of Geographic Thought 3(3+0)

This course surveys the major traditions of geographic thought from the early 20th century to the present. Attending to both 'human' and 'physical' perspectives in the discipline - as well as those that blur the lines between the social and natural sciences - we will explore the changing, contested nature of geographic knowledge in terms of its situated, historical contexts and its numerous reformulations in contemporary practice. In so doing, the course provides students with the background for understanding their research in terms of the philosophies and methods, and the convergences and departures that constitute the intellectual history of the discipline in general, and Geography at Madison in particular.

Contents

1. Nature of Geography
2. Evolution of Geography
3. Pre-classical and classical periods: ancient Geography
4. Medieval Geography: Muslim contributions, European contributions.
5. Modern Geography: Humboldt and Ritter, Geography from the middle of the 20th century, Dichotomies-physical and human, systematic and regional. Quantitative Revolution, Geo-informatics and Ecology.
6. Established traditions: Earth science, area study, spatial organization, man-land, system analysis and cartographic science.
7. Man-environment interaction themes: Environmental Determinism, Possibilism, Probabilism, Cognitive Behaviourism, World views on man-environment relationship.
8. Development of Nomothetic traditions: facts, concepts, hypotheses and paradigms, Ideographic vs. Nomothetic.
9. Philosophical framework: Positivism: Pragmatism, Phenomenology
10. Evolution of modern tools and models in geography
11. Development of geography in Pakistan

Recommended Texts

1. Dikshit R.K. (1998). *Geographical thought*. Upper Saddle River: Prentice Hall.
2. Ahmad, K.S. (2000). *Geography through the Ages*. Karachi: PGR.

Suggested Readings

1. Ayhew, S. (2008). *Geography*. London: Harmonds Worth.

2. Mitchel, B. (2000). *Geography and resources analysis*. New York: Norton & Company.
3. Tim, U. (1992). *The place of geography*. London: Longman.

GEOG- 5106 Surveying 3(1+2)

Surveying is the science of measuring and recording distances, angles, heights and sizes on the earth's surface to obtain data from which accurate plans and maps is made. It is the art and science of determining the position of natural and artificial features on, above the earth's surface or establishing such point and representing this information on paper plans, as figures, tables or computer based map. The basic concerns regarding a survey are spaces and locations within them. Survey essentially takes note of specific point locations for later reference. Surveying has been essential elements in the planning and execution of nearly every form of construction. One of the main functions of surveying is to acquire data on the shape and position of features on the ground, and to somehow delineate this information on maps, plans and drawings so as to make this data useful for other observers/users. These maps and plans can range from simple drawings in terms of sketches through to plans and maps, all based on some fundamentals of graphical communication

Contents

1. Introduction
2. Instrumental survey and records
3. Surveying using the following instruments
4. Chain survey
5. Plane Table
6. Prismatic Compass
7. Determination of heights and slopes with Abney Level
8. Contouring by Indian Clinometer

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. New Delhi: Vikas Publishing House Pvt. Ltd.
2. Singh, L. & Raghu, N. S. (2000) *Map work and practical geography*. New Delhi: Kalyani publishers.

Suggested Readings

1. Khan, M. Z. A. (1998). *Text Book of Practical Geography*. Delhi: Concept Publishing Company.
2. Bygott, J. (1952). *An introduction to mapwork and practical geography*. London: University Tutorial Press.
3. Bygott, J. (1955). *Mapwork and practical geography*. London: University Tutorial Press.

URCE-5104 Introduction to English Literature 3(3+0)

The course is designed to provide the familiarity and comprehension of English literary pieces. The students may not be familiar or well-versed in the various genres of literature prior to taking this course. The course provides training and skills necessary to engage, understand, critically analyze, and enjoy the literary genres of literature: short story, poetry, novel and drama. Thestudents will explore the basic concepts of literary technique, narrative, poetic, and dramatic structures and innovations to engage with the more advanced cognitive aspects of literature. In addition to these theoretical skills, students will also read below the surface of the texts for their historical, ethical, psychological, social, and philosophical value by developing insights in how literature gives us a window into both the experiences of others and wider appreciation for the human condition. The course explores literary production in English against local context in particular, by emphasizing shifts in thought as well as genre innovation, i.e. medieval to modern. It provides an introduction to key texts, authors and literary periods, exploring the relationship of texts to their contexts and considering multiple perspectives in the different literary genres.

Contents

1. Poems, Milton: *Book IX*, lines 897–959.
2. Shakespeare: All the World is a Stage.
3. Browning: My Last Duchess
4. Wordsworth: The Leech Gatherer
5. Keats: Ode to Autumn
6. Walter De La Mare: Tartary
7. Short Stories, *The Necklace*
8. The Woman Who had Imagination
9. Shadow in the Rose Garden
10. Essays, *My Tailor*
11. Whistling of the Birds
12. One Act Play, *Riders to the Sea*
13. Novel, *Animal Farm*

Recommended Readings

1. Kennedy, X. J., & Gioia, D. (2014). *Literature: An introduction to fiction, poetry, drama, and writing*. Boston: Pearson.
2. Mays, K. J. (2014). *The Norton introduction to literature*. New York: Norton.

Suggested Readings

1. Bausch, R & Cassill, R.V. (2006). *The Norton anthology of short fiction.* New York: Norton & Company.
2. Gardner, J. E., Lawn, B., Ridl, J., & Schakel, p. (2016). *Literature: A portable anthology*. Boston: Bedford St. Martins.

PSYC-5101 Introduction to Psychology 3 (3+0)

This course has been designed to ensure an effective orientation of students towards the discipline of psychology so that they may come to appreciate the diversity of the subject and its pragmatic significance. This course provides anintroduction to the concepts and theories of psychology and to their application to real life situations. Main objectives of the course include to make students familiar with the essentials features of human personality; to inculcate a sense of personal relevance of Psychology as a subject with the potential of gaining better insight into one's own self and others. Upon the successful completion of course students will have an introductory knowledge of selected areas of basic psychological enquiry and they will be able to: differentiate between scientific and non-scientific information about human behaviors and mental processes, describe major developments and research methods used in psychology; Explain psychological processes involved in sensation, perception, learning, memory, motivation, emotion, states of consciousness and health; Analyze the variety of factors affecting sensation, perception, consciousness, learning, memory, motivation, emotion, and health; and can apply psychological concepts and principles to situations in everyday life.

Contents

1. Introduction to Psychology: Definition of psychology, Goals of psychology, Major schools of thought in psychology, Major fields of psychology
2. Basic research Methods in Psychology: Survey research, Experimental research, Case study method
3. Biological Basis of Behavior: Brain and nervous system, Structure and function of major brain areas, Neurotransmitters and their functions
4. Sensation and Perception: Difference between sensation and perception, Principles of perception, Role of perception in human cognition
5. Motivation and Emotion: Concept &Theories of motivation and emotion
6. Learning: Definition of Learning, Types of Learning (i) Classical Conditioning (ii) Operant Conditioning, (iii) Observational Learning
7. Memory and Intelligence: Definition and stages of human memory, Types of memory, Concept of intelligence, Basic theories of intelligence

Recommended Texts

1. Weiten,W. (2017). *Psychology: Themes and variations*. Boston: Cengage Learning.
2. Nolen-Hoeksema, S., & Hilgard, E. R. (2015). *Atkinson and Hilgard's introduction to psychology*(16th ed.).New Dehli: Cengage Learning.

Suggested Readings

1. Flanagan, C., Berry, D., Jarvis, M., & Liddle, R. (2015). *AQA psychology.* London: Illuminate Publishing - Cheltenham.
2. Coon, D., Mitterer, J. O., & Martini, T. S. (2018*). Introduction to psychology: Gateways to mind and behavior*. Boston: Cengage Learning.

ECON-5112 Introduction to Economics 3(3+0)

The course is designed for beginners with either no formal background or very little acquaintance with economics. It develops the ability to explain core economic terms, concepts, and theories. The objective is to give the students a clear understanding of the basic concepts, tools of analysis, and terminologies used in microeconomics and macroeconomics. Emphasis will be on the use of graphs, diagrams, and numerical tables/schedules for exposition. A country's economy consists of three major economic agents; consumers, firms, and government. Analyzing the choices made by these economic agents is one of the main subjects of microeconomics. Students will learn how the decisions made by economic agents are represented in the market as demand and supply of commodities. Students will also learn about the determinants of macroeconomic conditions (national output, employment, and inflation), aggregate supply and demand, business cycles, public finance, international trade, and monetary and fiscal policy. The teacher is expected to draw examples from the surrounding world to clarify the concepts.

Contents

1. Introduction to economics and preliminaries
2. Theory of consumer behavior
3. Demand, Supply, market equilibrium and elasticities
4. Theory of production
5. Revenue and cost analysis of a firm
6. Theory of Market Structure
7. Firm's Behavior under perfect competition, monopoly, and monopolistic competition
8. Introduction to macroeconomics
9. National income and various concepts of national income
10. Consumption and saving function
11. Investment and its types,
12. Concept of aggregate demand and supply and their equilibrium
13. Concept of multiplier and accelerator
14. Monetary and fiscal policies
15. Inflation and unemployment (PHILLIPS CURVE)
16. Balance of payment problems and remedies
17. Public finance and taxation, debt and expenditure

Recommended Texts

1. Mankiw, N.G. (2018). *Principles of microeconomics*. Boston: Cengage Learning.

2. Diulio, E. A. & Salvatore, D.(2011). *Schaum's outline of principles of economics*. New York: McGraw-Hill Education.

Suggested Readings

1. Mankiw, N. G. (2019). *Macroeconomics*. New York: Worth Publishers.
2. Nicholson, W. & Snyder, C. M. (2010). *Intermediate microeconomics and its application*. Mason: Cengage Learning.
3. Froyen, R. T. (2013). *Macroeconomics: theories and policies*. University Chapel Hill: Pearson.

GEOG -6107 Regional Concepts 3(3+0)

Regional geography is a major branch of geography. It focuses on the interaction of different cultural and natural geo-factors in a specific land or landscape, while its counterpart, systematic geography, concentrates on a specific geo-factors at the global level. By the end of this course, the student will be able to describe what are geography and regional Geography and also major cultural region of the world. It focuses on major physical region and briefly explains major historical events and the impact of these events on World Geography. Students will get an introduction to the main regions of the world in terms of both their uniqueness and similarities. They will thus gain a perspective about social and cultural diversity of the world. Students will learn the relationships between the global, the regional and the local, particularly how places are inserted in regional and global processes. Students will be exposed to historical, economic, cultural, social and physical characteristics of regions, notably how they came to be, their main role and function and how they are changing. Students will see how human activities and the regional environment interact, particularly how societies reflect their regional environment.

Contents

1. Introduction to Regional Concepts
2. Scope, Status, and the significance of the regional approach, Regional approach and its evolution
3. Criteria for dividing world into regions
4. Physical Attributes: Location, Physiography, Climate, Soils, Hydrology and Natural Vegetation
5. Economic attributes: Human Resources, Mineral and Power resources, Agriculture, Industry, Communication and Trade
6. Types of Regions
7. Physical Regions, Economic Regions, Political Regions, Cultural Regions
8. Special Purpose Regions
9. Major Regions of the world
10. Role of the Region in Global Development

Lab. Work

Identification and delimitation of different types of regions on maps

Recommended Texts

1. Bradshaw, M. & White, G. W. (2007). *Contemporary world regional geography: global connections, local voices*. Boston: McGraw-Hill.

2. Deblij, H. J. D & Muller, P. O. (2011). *The world today: concepts and regions in geography* . New York : John Wiley & Sons.

Suggested Readings

1. Hobbs, J. (2010). *Fundamentals of world regional.* Boston: Cole Cengage learning.
2. Knox, P. L. & Marston, S. A. (2003). *Places and regions in global context: human* geography. New Jersey: Prentice Hall.
3. James. & Preston, E. (2000). *One world divided*. New Jersey: Prentice Hall.

GEOG -6108 Geomorphology 3(3+0)

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mold the landscape. Landforms are produced by erosion or deposition, as rock and sediment is worn away by these earth-surface processes and transported and deposited to different localities. The different climatic environments produce different suites of landforms. The landforms of deserts, such as sand dunes and ergs, are a world apart from the glacial and periglacial features found in polar and sub-polar regions. So geomorphology is a diverse discipline. Although the basic geomorphologic principles can be applied to all environments, Geomorphologists tend to specialize in one or two areas, such Aeolian (desert) geomorphology, glacial and periglacial geomorphology, volcanic and tectonic geomorphology, and even planetary geomorphology. Most research is multi-disciplinary, combining the knowledge and perspectives from two contrasting disciplines, combining with subjects as diverse as ecology, geology, civil engineering, and hydrology and soil science.

Contents

1. Scope and status of geomorphology
2. Introduction to geomorphic concepts/principles
3. Factors of landform development; structure, process and geological time scale
4. Endogenic Processes
5. Isostasy
6. Diastrophism
7. Continental drift
8. Plate tectonic
9. Volcanism
10. Earthquakes
11. Exogenic Processes
12. Weathering; mass wasting and their types

Recommended Texts

1. Thompson, G. R., & Turk, J. (1998). *Introduction to physical geology*. Brooks/Cole Publishing Company.
2. Thornbury, W. D. (2004). Principles of geomorphology. New York: John Willy & Sons.

Suggested Readings

1. Englen O.D.V. (2000). *Geomorphology*. New York: Macmillan.
2. Stringer, E. T. (2004). *Modern physical geography*. New York: John Wiley.

GEOG – 6109 **Climatology** **3(3+0)**

The course provides an overview of the physical processes responsible for determining global and regional climate. This course gives a general introduction to meteorology and climatology. Meteorology topics include energy balance, moisture and cloud development in the atmosphere, atmospheric dynamics, small and large scale circulations, storms and cyclones, and weather forecasting. Climatology topics include the interaction between the atmosphere and oceans over long time periods, climate classification, and the potential for climatic change. It brings together information from rural communities, indigenous peoples and research workers on how they use agro-biodiversity to cope with climate change. It stimulates communication between agro-biodiversity researchers, users and maintainers. It identifies tools and practices relevant to using agro-biodiversity for coping with climate change and making these widely available. It also promotes awareness of the vital role of agro-biodiversity in adapting to climate change among key audiences, including donors, development agents and the global biodiversity community.

Contents

1. Introduction.
2. Key concepts in climatology and meteorology.
3. Structure and composition of atmosphere.
4. Elements and factors of climate.
5. Insolation and Terrestrial heat budget.
6. Temperature distribution.
7. Humidity and its types; Condensation and their forms, Precipitation, formation and their types.
8. Atmospheric Pressure and global pressure belts.
9. Atmospheric Circulation: (Upper and Lower) air stability and instability, storms; Cyclones (hurricanes, typhoons) and tornadoes
10. Air masses and fronts.
11. Classification of climates; critical study of the Koppen, Miller and Thornthwaite classifications of major climates.
12. Climate variability and climate change: Natural and anthropogenic; Greenhouse gasses; global warming; acid rain, ozone layer depletion El-Niño and La-Niña, impact on precipitation distribution.
13. Climatic regions of Pakistan and their characteristics
14. Climatic data: sources, collection, analysis and presentation. Problems associated with data quality (spatial, temporal).

Recommended Texts

1. Miller A. (2001). *Climatology*. Haryana: Shubhi Publications.
2. Barry. R. (1998). *Atmosphere, weather and climate*. London: Routledge.

Suggested Readings

1. Shamshad, K.M. (1988). *The meteorology of Pakistan*. Karachi: Royal Book Co.
2. Strahler, A. N. (1998). *Elements of physical geography*. New York: John Wiley.
3. Diwan A. P. & Arora. D. K. (1995). *Origin of ocean*. New York: John Wiley.

GEOG - 6110 Economic Geography 3(3+0)

This course provides an introduction to economic geography. This course is an introduction to the theories, concepts, methods and data used by geographers to analyze the location of economic activities, the spatial organization of economic systems, the human use of the earth's resources and environmental issues. Topics studied include agriculture, manufacturing, transportation, retailing, urban structure, spatial diffusion and economic development.The course explores processes driving spatial patterns of economic activity at the global, national, regional, and local scales. Topic areas include economic globalization, spatial distribution of industrial sectors, multinational corporations, international trade, regional economic development, and illegal economic activities. The course looks at the development of the global marketplace in both the developed and the developing world. After the completion of this course student will be able to understand the significance of geographic concepts for socio-economic processes and the dynamics of the world economy, man's resource use and the pressure that population puts on the resource base.

Contents

1. Introduction (Definition ,Scope, Approaches to Study Economic Geography)
2. Branches of Economic Geography
3. Relationship with other Branches of the Geography
4. Producer and Consumer
5. Decision Making
6. Man Against Nature
7. Comparative Advantage
8. Perception
9. Evolution of world economic systems: Medieval feudal economics, economic impacts of colonialism. Modern world economic systems
10. Concept of natural resources and reserves
11. Human resource and its development
12. Classification of economic activities

Recommended Texts

1. Aoyama, Y., James T. M. & Susan H. (2012). *Key concepts in economic geography*. Singapore: SAGE.
2. Boyee, R. R. (2000). *The basic of economic geography*. New York: Holt, Rinehart & Winston.

Suggested Readings

1. Khan, F.K. (1998). *An introduction to economic geography*. Karachi: Oxford Publishers.
2. Knox, P & Agnew, J. (2008). *The geography of the world economy*. London: Edward Arnold.
3. Alnwick, H. (2012). *A geography of commodities*. London: Harrap.

GEOG - 6111 Quantitative Methods in Geography 3(3+0)

To train students in collection, analysis, interpretation and presentation of quantitative spatial data and to enable them to organize and conduct independent research. To use database software for the analysis of both Spatial and Temporal data. Quantitative techniques are the techniques that are concerned with collection, organization, presentation, analysis and interpretation of data. The quantitative techniques in geography are a recent development. The hard numbers behind any good research project are called quantitative data. Quantitative data is the language of science. It uses mathematical models, theories, and hypotheses. Quantitative data and qualitative data, in which you observe the non-numerical qualities of your subject, go hand-in-hand.

Contents

1. Introduction
2. Quantitative revolution and its impact on Geography
3. Parametric and non-parametric statistics
4. Nature of geographical data and measurement scales.
5. Data summarizing techniques
6. Theory of central tendency
7. Dispersion
8. Variability.
9. Time Series: graphs, growth and decline, index numbers, logarithmic scales, trends and fluctuations
10. Components of time series.
11. Methods of drawing trend lines for linear and exponential series scatter diagrams
12. Standard errors and probability, correlation and regression.
13. Quantitative models in Geography

Lab. Work

1. Introduction to EPI-Info SPSS E-view, MS Excel, MiniTab and other relevant software database for quantitative analysis.

Recommended Texts

1. Haring, L. L. (2002). *Introduction to scientific geographic Research*. Oxford: ECB.
2. Levin, J. (2006). *Elementary statistics in social research.* New Delhi: Pearson.

Suggested Readings

1. Matthew, H. & Foster, I. (2001). *Geographical data. sources, presentation and analysis.* London: Oxford University Press.
2. Mckillup, S. & Melinda, D. D. (2010). *Geostatistics explained*. Cambridge: Cambridge University Press.
3. Walford, N. (2011). *Practical statistics for geographers and earth Science*. Singapore: Wiley-Blackwell.

GEOG -6112 Principles of Cartography 3(1+2)

Cartography or mapmaking is the study and practice of making representations of the Earth on a flat surface. The discipline of cartography combines science, aesthetics, and technical ability to create a balanced and readable representation that is capable of communicating information effectively and quickly. Cartography is a complex, an ever-changing field, but at the center of it is the map-making process. Viewed in the broadest sense, this process includes everything from the gathering, evaluation and processing of source data, through the intellectual and graphical design of the map, to the drawing and reproduction of the final document. As such, it is a unique mixture of science, art and technology and calls for a variety of in-depth knowledge and skills on the part of the cartographer.

Contents

1. Evolution of Cartography
2. Basic geodesy, spherical, ellipsoidal and geoidal earth, geographical and planer.
3. Coordinates, properties of the graticule and geodetic position.
4. Map projections: Major types, merits and demerits of commonly used map projections.
5. Map Datum
6. Symbolization, symbol types and graphic variables
7. The symbolization problems, symbolizing graphic features.
8. Lettering principles.
9. Mapping statistical surfaces
10. Thematic map, choropleth, dot map, isolines, area cartograms.
11. Principles of cartographic design, general design problems; design of map symbols
12. Basic procedure and designing of the thematic maps such as topographic, climatic, economic, population, settlements, urban morphology etc.
13. Map production, form of map output, construction material, output options, composing separations, proofing.
14. Introduction to Digital Cartography
15. Terrain data (Digital Elevation Model/ Digital Terrain Model)

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. Karachi: Vikas Publishing House Pvt Ltd.
2. Singh. L. & Raghu naadam, S. (2000). *Map work and practical Geography*. New Delhi: kalyani publishers.

Suggested Readings

1. Ahmad. Z. (1998). *Text book of Practical geography*. Cambridge: Cambridge University Press.
2. Bygott, J. (2000). *An introduction to mapwork and practical geography*. University Tutorial Press.
3. Bygott, J. (2000). *Mapwork and practical geography*. New Delhi: University Tutorial Press.

GEOG - 6113 Oceanography 3(3+0)

It describes knowledge about world's oceans their distribution, and its resources. To produce the students with the applicable knowledge about existence of oceans, formation of ocean floors, their distribution and effects of climate and ocean resource management. It may identify the impact of basic and applied knowledge of oceanography, to impart skills on the ocean distribution, existence of oceans, and availability of resources in oceans. It discusses the spatial distribution of oceans and their effects Land, Ocean and atmosphere relationship, to study ocean currents, variability, and Mechanism. It will also discuss the law of sea and country rights for associated oceans and seas. It will discuss the ocean habitat to study the ocean resources and law of ocean territory.

Contents

1. Introduction
2. Origin of oceans and seas
3. Major water masses and their distribution.
4. Morphology of the ocean basins.
5. Ocean floor deposits.
6. Their characteristics and classification.
7. Temperature, salinity and density of ocean water
8. Distribution, causes and effects
9. Oceanic circulation: waves, currents and tides, their nature, causes, effects and impact on environment.
10. Special phenomena: tropical storms; Tsunami.
11. Oceanography of Arabian Sea with special reference to Exclusive Economic Zone.

Lab. Work

Drawing features of the Ocean floor, mapping of the ocean currents, tides and associated phenomena.

Recommended Texts

1. Douglas A. Segar. (1998). *Ocean sciences.* Boston: Wadsworth publishing Company.
2. Barnes, H. (2000). *Apparatus & methods of oceanography*. London: George Allen &Unwin Ltd.

Suggested Readings

1. Duxbury, A.B & Duxbury, A.C. (1994). *An introduction to the world oceans*. Oxford: WMC Brown Publishers.
2. King, C.A.M. (2000). *Oceanography for geographers*. London: Edward Arnold Publishers, Ltd.
3. Pinet, P.R. (2002). *Invitation to oceanography*. London: Jones & Bartlett Publishers.

GEOG -6114 Remote Sensing 3(2+1)

It describes about knowledge of Remote Sensing (RS) and its practical implementation. To produce students, that has applicable knowledge about basic tools of GIS. The course aims to equip students with an understanding of GIS, evolution and applications of spatial data through Geo-spatial technologies. Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area. Special cameras collect remotely sensed images of the Earth, which help researchers "sense" things about the Earth. It introduces knowledge of recording earth's surface features from space-borne platforms and different ways in which images can be analyzed. It will enable students to develop an understanding of common remote sensing products such as, earth resources satellite images, aerial photographs etc to develop a comprehension regarding ground-truthing aided by GPS.

Contents

1. Introduction
2. History and Development
3. Concepts and Foundation of Remote Sensing and Electromagnetic spectrum
4. Visible Spectrum, Colour Theory
5. Atmospheric Attenuation
6. Types of Remote Sensing Systems
7. Type of Sensors
8. RBV, MSS, TM,HRV, HRPT/APT/AVHRR, MODIS (Terra and Aqua) non-imaging systems (RADAR)
9. Types of Satellites
10. Telecommunication, Spy, Scientific etc.)
11. Platforms (Orbits)
12. Ground Receiving Stations (Reception of Data)
13. Image Processing
14. Global Positioning System (GPS)
15. Applications of Remote Sensing
16. Remote Sensing in Pakistan: Potential and Prospects.

Recommended Texts

1. ITC (2004). *Principles of remote sensing*. Netherlands: ITC Educational Textbook Series.

2. Campbell, J. B. & Wynne, R. H. (2011). *Introduction to remote sensing*. New York: Guilford Press.

Suggested Readings

1. Iliffe, J. & Lott, R. (2008). *Datums and Map Projections for remote sensing, GIS, and Surveying* (2nd ed.). Manchester: Whittles Publishing.
2. Jensen, J. (2005). *Introductory remote sensing*: *Principles and Concepts*. New York: Freeman & Co.
3. Jensen, J. R. (2011). *Remote sensing of the environment: an earth resource perspective*. New Jersey: Prentice Hall.

GEOG- 6115 Research Methods 3(3+0)

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Each research study has its own specific purpose, we may think of research objectives are: to create awareness among students regarding basics of geographical research. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies); To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies); To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies); To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

Contents

1. Introduction Research approaches
2. Research paradigms in Geography
3. Types of research: historical research, qualitative/descriptive research, quantitative/experimental research
4. Research design; research topic, formulation and statement of a problem, research questions, research hypotheses, research objectives, research plan
5. Literature review; Literature sources: Journals (types) Books, Monographs and web sources
6. Data collection, universe and sampling: primary and secondary data, sources of data
7. Selection of a sample and measuring instruments, basic considerations in sampling, size of sample, geo-statistical
8. considerations, Sampling units and design; points, traverses, random sampling, stratified sampling, systematic sampling
9. Field Techniques
10. Data analysis and interpretation: pre-analysis considerations,
11. Preparing data for analysis: use of the descriptive statistics and quantitative methods.
12. Data presentation
13. Research report writing; Proposal and Synopsis writing
14. Bibliography and references

Recommended Texts

1. Therese, L. B. (1999). *Doing social research*. Boston: McGraw Hill.
2. Nicholas J. Clifford & Gill V. (2003). *Key methods in geography*. London: Sye Publications.

Suggested Readings

1. Keith Hoggart, Loretta Lees & Anna Davies (2002). *Researching human geography*. London: Arnold Publishers.
2. Dr. K. L. Narasimha Murthy (1992). *Research in geography: a survey*1st Ed.; Ashish Publishing House, New Delhi.
3. John W. Best & James V. Kahn, (2003). *Research in education*. New Dehli: Printice Hall Private Ltd.

GEOG - 6116 Population Geography 3(3+0)

This course introduces population geography to advanced undergraduate students, and graduate students. We will examine how and why aspects of population have been understood as 'problems' in different and times. he syllabus coverts the major concepts and basic tools of demography; key geographical and historical processes of population change such as fertility, mortality and migration; and the socio-economic, political, and environmental causes and consequences of population dynamics in different world regions and over time. The population dynamics are discussed in a way that incorporates economic, political, cultural and environmental issues. To develop this critical geographic approach to population issues, we will places examine trends in population, population patterns at several scales (global, national, urban) and the population processes (fertility, mortality, migration) that create them. Further, we will investigate how population processes are shaped by, and engender, larger processes of political, environmental, urban, economic, and cultural change.

Contents

1. Introduction
2. Population theories
3. Sources and methods of population data collection and associated problems
4. Population distribution
5. Density
6. Urban and rural population
7. Population composition
8. Gender composition
9. Age structure, marital status, families and households, languages, religions, ethnic groups etc.
10. Population dynamics
11. Patterns of fecundity and fertility
12. Morbidity and mortality
13. Migration and its types
14. Demographic transition
15. Population growth and change
16. Population Projections

Lab. Work

Consultation of the Population Census of Pakistan and representation of population data on maps.

Recommended Texts

1. Newbold, K. B. (2017). *Population geography: tools and issues*. Toronto: Rowman & Littlefield.
2. Ardagh, M. (2013).*Textbook of population geography.* New Delhi: Random Exports.

Suggested Readings

1. John. I. C. (1997). *Population geography*. Toronto: Rowman & Littlefield.
2. Majid, H. (1994). *Population geography.* Karachi: Anmol Publications
3. Polunin, N. (1998). *Population and global security.* Cambridge: Cambridge University Press.

GEOG -6117 Geographical Information System 3(2+1)

The course aims to equip students with an understanding of GIS, evolution and applications of spatial data. In this class, students will be introduced to the study and design of maps, primarily through the application of a specialized computer mapping software program known as a Geographic Information System (GIS). GIS is a map-based computer decision support system that allows for the investigation of geographic data relationships. People that are trained in GIS are in high demand today, both in government and private industry. The lecture sessions in this class will focus primarily on GIS-based mapmaking techniques, including map design, symbology, map coordinates and georeferencing systems. Students will cover many important aspects of mapmaking, including map data collection and processing, field methods and GPS, cartographic communication, topographic map reading and analysis, and qualitative and quantitative mapping techniques.

Contents

1. Introduction
   Definitions, key components, functional subsystem, Raster data model, vector data model, attribute model, Data acquisition techniques, data sources, data capturing techniques and procedures, data visualization of spatial data, layers, projections and transformation and datum.
2. Map design
   Symbols to portray points, lines, polygons and volumes,graphic variables, visual hierarchy, Data classification graphic approach, mathematical approach.
3. Spatial analysis
   Neighborhood functions, network, and overlayanalysis, buffering, spatial data quality, components of data quality, micro level components, macro level components, usage components, sources of errors, accuracy and resolution and uncertainty.
4. GIS Applications

Recommended Texts

1. Chang, K.. (2006). *Introduction to geographic information systems*. Boston: McGraw-Hill Higher Education .
2. Demers, M.N. (2002). *Fundamentals of geographic information systems*. New York: John

Wiley & Sons.

Suggested Readings

1. Yeung., Lo, C.P. & Lal, A. K. (2003). *Concepts and techniques of geographic information system.* New Dehli: Prentice Hall.
2. Kiser, J.D., & Paine, D.P., (2003). *Aerial photography and image interpretation*, New York: John Wiley & Sons.
3. Janssen, L. L., &Huurneman, G. (2000). *Principles of remote sensing*: ITC, International Institute for Aerospace Survey and Earth Sciences.

GEOG- 6118 Environmental Geography 3(3+0)

Environmental Geography, one of the most traditional parts of the discipline of Geography, encompasses natural science, social science, and humanistic understandings of the Earth's environment. Environmental Geographers study the complex relationships between humans and the natural environment over time and through space. This course will provide a historical, geographical, and humanistic foundation for understanding the environment and the plethora of environmental issues that confront us at the beginning of this century. It is a major aim of this course to produce environmentally aware students and to equip them with skills to enable them to become future decision-makers on environmental matters in whatever field they wish to pursue in the future. By studying this course students will be able to recognize what the issues are, and to view them from a geographic perspective. They will recognize the responsibilities they have in relation to other people, the environment, and sustainability, and there will be opportunities to initiate personal action.

Contents

1. Evolution of Environmental Studies in Geography
2. Comparative Advantage of Geography
3. Concept of environmental management
4. Environment and Man interaction, Ecosystem, natural resources
5. Important Cycles
6. Population explosion, The human impact on the environment
7. Environmental hazards, Types of Hazards
8. Major Environmental hazards and Problems in Pakistan: Floods, Earthquake, Tsunami, Cyclones, Landslides, Droughts, Deforestation and Desertification
9. Water-logging and Salinity
10. Soil Erosion
11. Global Warming and ozone depletion
12. Environmental Pollution , Waste Management, Control and Mitigation Measures, Technology, awareness, Legislation, Ethics
13. Pakistan Environmental Act
14. National Conservation Strategy
15. National Environmental Quality Standard

Recommended Texts

1. Arms, K. (2001). *Environmental science*. Philadelphia: Asunders College Publishing.
2. Basak, A. (2009). *Environmental studies.* New Delhi: Pearson.

Suggested Readings

1. Botkin, D. B. & Edward A. K. (2012). *Environmental science*. Hoboken: John Wiley & Sons.
2. Burton, I. R., W. Kates& Gilbert. F. W. (2000). *The environment as hazard.* Karachi. Oxford University Press.
3. Cunningham, W. P. (2007). *Environmental science: a global concern*. Boston: McGraw-Hill Higher Education.

GEOG -6119 Urban Geography 3(3+0)

This course explores the setting in which more than half of the world's people live--the city. Cities are the largest human artifacts, but how do they emerge and evolve? What are the similarities and differences between cities? Why is the Central Business District of some cities thriving while others decline? These and many other questions are examined by urban geographers. This course will explore and analyze the various aspects, concepts and approaches of urban geography. The course will cover topics such as historic and contemporary urban development; spatial dimensions of the city; social and economic patterns; images of the city; inequality and the development of urban built environment. Throughout history, cities have been the centers of economic, political, and cultural life. Further, many of the critical issues of our time--social polarization, economic restructuring, environmental degradation, and poverty--are concentrated in urban areas. This course explores the relationships among cities in a global urban system as well as the internal spatial arrangement of cities. It asks questions about how people structure the spaces of cities as well as about how people's lives are affected by the ways cities are structured.

Contents

1. Origin of towns.
2. Site and situation concept.
3. Process of urbanization in the world.
4. Urban function, economic base of urban centers.
5. Formal and functional classification of towns
6. Towns as central place
7. Urban hinterland.
8. Urban structure-different theories
9. Hierarchy of settlements-city size distribution
10. Rank size Rule
11. Law of primate city.
12. Urban expansion, metropolitan decentralization
13. Rural urban fringe-urban social life.

Recommended Texts

1. Pacione, M. (2013). *Urban geography: A global perspective*. London: Routledge.
2. Wheeler, J. O., & Holloway, S. R. (2004). *Urban geography*. Hoboken: John Wiley & Sons Inc.

Suggested Readings

1. Douglas, I., Goode, D., Houck, M., & Wang, R. (Eds.). (2010). *Handbook of urban ecology*. London: Routledge.
2. Mayer H.M. & Kohn C.F. (2000). *Readings in urban geography*. Chicago: University of Chicago Press.
3. Smailes, A.E. (2000). *The geography of towns*. London: Hutchinson and Co.

GEOG -6120 Digital Image Processing 3(2+1)

It describes knowledge about knowledge about Digital Image processing (DIP) and its practical implementation. To produce students, that has applicable knowledge about basic tools of image processing and sensor's system. The course aims to equip students with overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation, and morphological image processing. Since 1964 the advent of large-scale digital computers and the space program have made digital image processing one of the most rapidly growing fields in electrical engineering. Now image processing has found much more wide applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, law enforcement, defense, intelligence. With the progress made in multimedia these days, digital image processing finds more wide applications. It has become an indispensable part of our digital age.

Contents

1. Multispectral, Thermal and Heperspectral Scanning
2. Satellite Systems
3. Digital Image Processing and Image Enhancement
4. Introduction, Image Rectification and Restoration, Image Enhancement, Contrast Manipulation
5. Spatial Feature Manipulation, Multi-Image Manipulation
6. Image Classification
7. Data Merging and GIS Integration
8. Geometric Image Correction, Spectral Image Enhancement, Spatial Image Enhancement - Operations in Spatial Domain, Spatial Image Enhancement - Operations in Frequency Domain
9. Image Classification – Supervised and Unsupervised Classification
10. Image Classification - Object Oriented Classification
11. Microwave Sensing
12. Application of Remote Sensing
    Land Cover Mapping, Land use change monitoring, Urban expansion Mapping, Environmental

Monitoring, Cadastral Mapping

Recommended Texts

1. Lilles T. M. & Kiefer, R. W. (2004).*Remote sensing and image interpretation.* New York: John Wiley & Sons.
2. Campbell, J. B. &Wynne, R. H. (2011).*Introduction to remote sensing*. New York: Guilford Press.

Suggested Readings

1. Lo, C. P. (2000). *Applied remote sensing.* Essex: Longman.
2. ITC (2004). *Principles of remote sensing*. ITC Educational Textbook Series. Enschede, The Netherlands.
3. Muralikrishna, I. V. (1992). *Remote sensing applications and geographic information systems.* New Delhi: McGraw Hill.

GEOG - 6121 Geography of Pakistan 3(3+0)

Pakistan Geography is a vital topic for study because it allows a student to understand the planet in a way that clarifies various global political issues and to see the relationship between people, groups and the physical environment in which they live. Geography gives us information about various types of climates, natural conditions, mineral wealth etc. of the various nations. As the world becomes more interrelated and interdependent through technological advances, it is increasingly important to understand the physical and cultural differences of other places. Studying of Pakistan geography also opens a link to understanding the history of one's own culture, as well as that of others. An understanding of geography also allows one to make smart choices when dealing with issues regarding the relationship of society to the physical environment.

Contents

1. Introduction
2. Geo-strategic position of Pakistan
3. Location and Geographical significance
4. Geo-political Importance
5. Administrative setup
6. Land and Physical Environment:
7. Physiography
8. Climate and climatic regions o Hydrology
9. Soils and vegetation
10. The People
11. Population characteristics: structure, composition and distribution
12. Population Change
13. Urbanization
14. Economy
15. Agriculture (crops and livestock)
16. Irrigation

17. Power and mineral resources
18. Industries
19. Trade
20. Tourism
21. Transport and Communication
22. Major challenges of Pakistan
23. Water, power, security and environmental issues

Recommended Texts

1. Khan, F. K. (2015). *Geography of Pakistan.* Karachi: Oxford University Press.
2. Ahmad, K. S. (2000). *Geography of Pakistan.* Karachi: Oxford University Press.

Suggested Readings

1. Burkey, J. S. (1991). *Pakistan the continuing search for nationhood.* Oxford: Western Press Oxford.
2. Davidson, A. P. & Ahmad, M. (2003). *Privatization and the crisis of agricultural extension: the case of pakistan, king's soas studies in development geography.* New Delhi: Ashgate Publishing.

GEOG - 6122 Cultural Geography 3(3+0)

This course provides an overview of the field of cultural geography. This area of study centers its attention on spatial variations among cultural groups and the special functioning of society, and the changing and multifaceted relationships between people and the environments in which they reside. Students will learn the basic geographical tools and concepts needed to understand the intricacy of spaces and areas and to appreciate the interconnections between their lives and those of people in different parts of the world. The course provides knowledge of and about the creation of places and regions, an understanding of both the interdependence of places and regions in globalizing world, and the major changes that have taken place in global, regional, and local landscapes.

Contents

1. Introduction
2. Definition of Culture & Cultural Geography, Scope of Cultural
3. Geography & its relationship with other Disciplines.
4. Basic themes of cultural geography:
5. Cultural Ecology
6. Cultural Diffusion
7. Cultural Regions/Area
8. Cultural Integration
9. Cultural Landscape.
10. Cultural History:
11. Paleolithic Age: Hunting & Gathering Culture
12. Neolithic Age: Agricultural World Revolution.
13. Industrial Revolution & Urbanization
14. Detailed Study of Stages of Social Cultural Change
15. Geo-Cultural Study of the following:
16. Religion

Recommended Texts

1. Fouberg, E. H., Murphy, A. B., & De Blij, H. J. (2009). *Human geography: people, place, and culture*. New York: John Wiley & Sons.
2. Terry G. J. Lester R. (2000). *Human mosaic.* New York: Harper Collins Publishers.

Suggested Readings

1. Atkinson, D., Jackson, P., Sibley, D., &Washbourne, N., (2005). *Cultural geography: A critical dictionary of key ideas.* IB Tauris.
2. Anderson, K., Domosh, M., Pile, S., & Thrift, N., (2002). *Handbook of cultural geography*. Singapore: Sage.
3. Horton, J., & Kraftl, P., (2013). *Cultural geographies: An introduction*. London: Routledge.

GEOG - 6123 Natural Hazards and Disaster Management 3(3+0)

This course covers the mitigation concepts, implementation approaches planning and types of Hazards. It is a multidisciplinary research oriented subject for planning and development. This is a course on applied hazard mitigation, but because it is a graduate level course, the focus will not be only on the fundamentals of hazard mitigation but on the fundamentals and their application. Students have had some introduction to hazard mitigation through NHDM. The application aspect of this course addresses the relationship of hazards and their behaviors which cause disasters and how local, state, and federal emergency management agencies can mitigate the potential threats. Hazard mitigation is actually hazards management, much like emergency preparedness, response, and recovery have to with disaster management. Thus, in emergency management we deal with both hazards and disaster management. The approach used in this present course is to address hazards management or the management of hazards so that future disaster impacts will be reduced or eliminated.

Contents

1. The Concept
2. The Nature of the Phenomena
3. Dynamics of Potentially Disastrous Natural Hazards
4. Impact of Natural Hazards and Likely Disasters
5. Scale
6. Risks
7. Vulnerability
8. The Disaster Management Cycle
9. Application of RS, GIS, GPS Tools in the Management of following Natural Hazards / Disasters
10. Flood
11. Earthquake
12. Cyclones
13. Rainfall

14. Efficacy of the Integrated Development Planning and Natural Hazards/ Disasters

Recommended Texts

1. Bryant, E. (2005). *Natural hazards*. Cambridge: Cambridge University Press.
2. Cochrane, M.A. (2009). *Tropical fire ecology: climate change, land use and ecosystem dynamics*. Springer: Praxis Publishing.

Suggested Readings

1. Ghosh, G.K. (2006). *Disaster Management*. New Delhi: A.P.H Publishing Corporation.
2. Pirarizy, A.A. (2002). *Environmental Geography and Natural Hazards*. New Delhi: A.P.H Publishing Corporation.
3. Smith, K. (2004). *Environmental Hazards. Assessing Risk and Reducing Disaster*. London: Routledge.

GEOG - 6124 Geography of Manufacturing 3(3+0)

The term "manufacturing" includes those activities by which man changes the form or nature of raw materials, converting them into more useful products. The course focuses on explanations of factory location, the role of location in corporate strategies and the geographical structure of production systems, including industrial districts. Particular attention is paid to the organizational structure of the economy, especially the dominant role played by multinational firms (MNCs), and the forces that shape the agglomeration and dispersal of activity. These transforming operations are conducted in factories, to which are brought raw materials from various source regions and from which go finished products to diverse market regions. Factories which characterize industrial regions may be interrelated: some may supply semi-finished items to other factories; others may be branch plants; and still others may have a service relationship, such as a power plant, which supplies electrical energy to other factories. A relationship also exists between factories and non-factory elements.

Contents

1. Introduction to Geography of Manufacturing:
2. Definitions and concepts, and organization.
3. Classification of industrial activities.
4. Historical Development of Industrial Activity:
5. From industrial revolution to green paradigm.
6. Modern trends in manufacturing.
7. Industrial Location:
8. Approaches to location dynamics.
9. Location factors.
10. Location models.
11. Location theories.
12. Geographical Analysis of Selected Industries:
13. Light industries (Cotton textiles, sugar industry)

14. Heavy industries (Iron and steel, petro-chemicals, cement)
15. Modern Issues in Manufacturing:
16. Patterns of international production and the industrialization process.
17. De industrialization.
18. Industry and environmental problems.
19. Industrial planning and management.

Recommended Texts

1. Alexanderson, G. (2000). *Geography of manufacturing*. Englewood Cliffs: Prentice Hall Publications.
2. Altaf, Z. (2000). *Entrepreneurship in the third world risk and uncertainty in industry in Pakistan.* London: Croom Helm, Ltd.

Suggested Readings

1. Chapman, K. & Walker, D.F. (1991). *Industrial Location*. (2nd ed.). Oxford: Wiley Eastern Ltd.
2. Emery, J.S. & Shaw, J.H. (2000). *Cities and Industries*. Milton: Jacaranda Press.
3. Hayter, R. (2000). *The Dynamics of Industrial Location.* New York: John Wiley & Sons.

GEOG - 6125 Hydro Geography 3(3+0)

It describes advanced knowledge about Water resources, water resource management, Hydrology, distribution and availability of water. This course provides a basic introduction to hydrologic processes, including fundamentals of hydrology, rainfall-runoff modeling, hydraulic processes (including both pressurized pipe flow and open channel flow), and hydrologic frequency analysis. These fundamentals are then applied in the computation of design flows and in the analysis and design of hydraulic systems such as pipe networks and storm water management systems. Computational laboratory sessions (including geographic information systems and simulation models) and experimental laboratory sessions reinforce lectures and provide hands-on learning opportunities. By the end of this course, students should be able to apply standard techniques, computational tools, and data used by engineers in conducting hydrologic analysis.

Contents

1. Introduction
2. Hydrological Cycle and Water Balance: Water Reservoirs, Hydrological Cycle, Water Balance
3. Precipitation and Rainfall
4. Runoff: Factor affecting the Runoff, Runoff Cycle and Phases of Runoff, Measurement of Runoff
5. Ground Water
6. Floods: Causes and Seasonal Distribution of Floods, Flood Protection and Planning, Geographical Distribution of Floods
7. Glacial Water: Glacial Nourishment and Wattage, Glacial Runoff, Glacial Flow, Response of Glacier to Climatic Changes
8. Droughts: Extent and Distribution of Droughts, Drought Severity, Frequency and Duration, Hydrological Relations in Draughts

9. Lakes: Origin and Diversity, Hydrological Cycle and Water Balance Lakes, Geographical Distribution
10. Water Pollution: Classification of Water Pollutants, Extent and Distribution of Water Pollutants, Effects of Water Pollution on Fauna and Flora
11. Quantitative Hydro Geography: Basis Concepts, Areal Aspects of Drainage Basins
12. GIS and RS Application:

Recommended Texts

1. Raghunath, H. M. (2006). *Hydrology: principles, analysis and design*: New Age International.
2. Ward, R.C. & Robinson, M. (2000). *Principles of hydrology*. London: McGraw Hill.

Suggested Readings

1. Bittinger, M. W. (2000). *Water resources, use, and management.* Proceedings of a symposium held at Canberra. Edwin S. (Hill, Eds). Cambridge: Cambridge University Press.
2. Meinzer, O.E. (2000). *Hydrology.* New York: McGraw Hill.
3. Chow, V. T. (2000). *A handbook of applied hydrology.* New York: McGraw Hill.

GEOG -6126 Medical Geography 3(3+0)

Medical geography is an important "new" area of health research that is a hybrid between geography and medicine dealing with the geographic aspects of health and healthcare. Medical geography studies the effects of locale and climate upon health. It aims to improve the understanding of the various factors which affect the health of populations and hence individuals. It is also called health geographics. Focuses on the design of GIS-based models to address health and healthcare issues. Topics include a conceptual framework, landscape epidemiology models, disease diffusion models, health accessibility, human health behavior and location-allocation of health services. Laboratory section provides hands-on experience applying these models with GIS tools.

Contents

1. Introduction to Medical Geography:
2. Definitions, themes, concepts, Nature & scope of Medical Geography
3. The Historical Development of Medical Geography
4. The status of Medical Geography.
5. Factors inflecting the Patterns of Health & Disease:
6. Geographical Factors.
7. Physical Factors / Environmental Factors.
8. Cultural Factors.
9. Socio – Economic & Political Factors.
10. Patterns & Processes of Health & Disease:
11. Spatial variations in health & welfare patterns.
12. Role of Geography in exploring the impacts of diseases.
13. Models in Medical Geography

14. Epidemiological Transition
15. Health & inequalities
16. Inverse care law.
17. Global Patterns of health & Disease.
18. Global Eradication of disease.
19. Progress in Medical Geography:
20. Recent Issues & Developments in Medical Geography.
21. GIS, Remote Sensing & Health studies.
22. Changing Societies & future Health care.
23. Geography, Health care & Planning.

Recommended Texts

1. Lloyd, J. (2002). *Health & welfare*. London: Holder & Stoughton.
2. Izhar, F. (2004). *Geography & Health: A study in medical Geography.* New Delhi: A.P.H. Publishing Corporation.

Suggested Readings

1. Leninan, J. & Fletcher, W.W. (2000). *Health & the environment* (1st ed.). Glasgow: Blacker & Sons Ltd.
2. Lloyd, J. (2002). *Health & welfare,* Holder & Stoughton London.

GEOG –6127 Political Geography 3(3+0)

Political geography is concerned with the study of both the spatially uneven outcomes of political processes and the ways in which political processes are themselves affected by spatial structures. In this course, we will survey Political Geography, a subfield of Human Geography which focuses on questions of space and power and the interconnections of geography and politics. All politics are geographical, from the spatial arrangement of local governments to the territorial basis of international trade. We will explore how politics works with a concern for where political impacts occur at a variety of geographical scales (from the international to the local) while also considering how geographical factors impact political actions. We'll also examine the geography of various formal institutions and practices of politics as well as the informal politics of everyday life within places. In short, we'll explore how political power makes geographies and how, in turn, geography may be said to make politics.

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Contents

1. Nature and objectives of Political Geography, Definition and development of political geographic thought.
2. A critical examination of the following:
3. Concept of environmental relationship in political geography.
4. The concept of geopolitics its development and short-comings
5. National deterministic theories of Germans and French possibilities.
6. State as a Politico-geographic Phenomenon:
7. Concept of the state and its classification. Chief political-geographic characteristics of states.
8. Hierarchy of political area.
9. Frontiers and boundaries: their concepts, functions and classification.

10. Core areas, ecumenical area and capitals.
11. Approaches and forces in the politico geographic study of state:
12. A critical examination of the following approaches:
13. Simple descriptive approach.
14. Historical approach.
15. Morphological approach.

Recommended Texts

1. Jones, M., Jones, R., Woods, M., Whitehead, M., Dixon, D., & Hannah, M. (2014). *An introduction to political geography: space, place and politics*. London: Routledge.
2. Kruys, B. G. G. (2002). Controlling land borders: A comparison of the United States of America, Germany and South Africa. *Strategic review for southern Africa*, *24*(2), 114.

Suggested Readings

1. Agnew, J. (1997). *Political geography: a reader*. London: Arnold.
2. Bakis, H. (1995). Communication and Political Geography in a Changing World' *Revue Internationale de Science Politique, 16* (3). 219–311.
3. Williams, N. (2009). *Border Politics: The limits of sovereign power: the limits of sovereign power*. Edinburgh: Edinburgh University Press.

GEOG - 6128 Regional Planning & Development 3(3+0)

Regional planning deals with the efficient placement of land-use activities, infrastructure, and settlement growth across a larger area of land than an individual city or town. Regional planning is a sub-field of urban planning as it relates land use practices on a broader scale. This course will explore and analyze the various aspects, concepts and approaches of urban geography. The course will cover topics such as historic and contemporary urban development; spatial dimensions of the city; social and economic patterns; images of the city; inequality and the development of urban built environment. It also includes formulating laws that will guide the efficient planning and management of such said regions. Regions require various land uses; protection of farmland, cities, industrial space, transportation hubs and infrastructure, military bases, and wilderness. Regional planning is the science of efficient placement of infrastructure and zoning for the sustainable growth of a region.

Contents

1. Principles and Scope of Planning and Development
2. Planning: A Geographer's View, ii. Planning Processes
3. Planning as an Activity
4. Objectives in Planning
5. Objectives of Regional Development Efforts.
6. Implications of Regional Development:
7. Defining Regions, ii Regional Hierarchy and Classification, iii. Regionalism or Administrative Boundaries?, iv. Determining Regional Boundaries, v. Factors contributing to Uniformities and Disparities in Regions, vi.
8. Resources and Planning:
9. The Resource Base.

10. Resource Evaluation.
11. Utilization of Resources for Planning and Development.
12. Urban and Regional Planning:
13. Urban Growth Patterns.
14. Impact of Industrialization.
15. Planning for Cities and City Regions.
16. Rural Planning:
17. Agricultural Planning and Rural Development.

Recommended Texts

1. Hall, P. (2000). *Urban and regional planning* (2nd ed.). London: Allen &Unwin.
2. Hudson, R. & Lewis J.R. (2000). *Regional planning in Europe*. London: Pion Ltd.

Suggested Readings

1. Birmingham, W., & Ford, A.G., (2000). *Planning and growth in rich and poor countries*. London: George Allen and Unwin Ltd.
2. Cox, K. R. (2000). *Location and public problems*. Oxford: Basil Black-Well.
3. Frey H. (1999). *Designing the city towards a more sustainable Urban Form*. London: Routledge.

GEOG - 6167 Agricultural Geography 3(3+0)

Agricultural geography is a sub-discipline of human geography concerned with the spatial relationships found between agriculture and humans. Agricultural Geography provides the basic information of various types of the agriculture on the earth surface viz., Subsistence, commercial, horticulture, specialized etc. Agricultural Geography as a sub-discipline of human and economic geography. The geography of human activities is called as 'economic geography' which examines the primary, secondary, tertiary and quaternary activities of man. Man in his primeval stage was a hunter and gather and during the Neolithic period he learned the art of cultivation of crops. Thus, agriculture had been the dominant economic activity in the past and it is still the mainstay of over two-third of the world population. The study of agricultural geography is thus of great social relevance among all the branches of human geography

Contents

1. Introduction to agricultural geography:
2. Nature and scope
3. The origins and development of agriculture
4. Theoretical aspects of geographical location relevant to agriculture
5. Introduction; approaches to the study of agriculture in geography
6. Approaches: commodity, regional, deterministic, systematic
   factors influencing agricultural patterns:
7. Physical factors: the terrain, climate, soil, water resources
8. Socio-economic factors: technological, population, cultural, infrastructure
9. Land, labour and capital

10. Government and regional policies, models in agricultural geography:
11. The nature and need of models
12. Classification of models
13. Models of agricultural activity, agricultural regions: concepts and techniques:
14. Concept and methodology
15. Techniques: normative, empirical, single element, statistical
16. Methods of agricultural regionalization
17. Data classification and distribution

Recommended Texts

1. Newbury, P. A. R. (1999). *Agricultural geography*. London: Longman.
2. Shukla, L. (2011). *Readings in agricultural geography*. Jaipur: Scientific Publisher.

Suggested Readings

1. Laingen, C. & L. Butler, H. (2013). *Agricultural geography*. Oxford Bibliographies. Oxford: Oxford University Press. DOI 10.1093/OBO/9780199874002-006
2. Bowler, I. R. (2002) *The industrialization of Agriculture*. Oxford: Oxford University Press.
3. Singh, J. & Dhillon, S. S. (2000). *Agricultural geography.* New Delhi: McGraw-Hill.

GEOG - 6168 Conservation of Resources 3(3+0)

Natural resources conservation workers strive to protect natural resources, such as water, soils, minerals, forests and wildlife. Studies in natural resources conservation are multidisciplinary, covering topics in resource management, recreation, development and ecosystems. Conservation includes both the protection and rational use of natural resources. Earth's natural resources are either nonrenewable, such as minerals, oil, gas, and coal, or renewable, such as water, timber, fisheries, and agricultural crops. We need to conserve our Natural Resources because it is the main source of our daily needs. We need to conserve it because they are limited only. And if these resources are abused and harmed, we will have short quantity of sources for food and living. Remember our future generation will need also our Natural Resources.

Contents

1. Scope of the subject; its importance, problems created by the expanding population
2. Advancing technology, increasing standings of living and greater demand for space and goods thereof
3. Relation of subject to other disciplines.
4. Agricultural Resources,
5. Agriculture and man. Types of agriculture, agricultural land use and cropping pattern. Efficiency of agriculture, problems relating to agricultural land. Agricultural regions of the work.
6. Animal Resources:

Ranching and pasture, problems of overgrazing, carrying capacity of land, recent changes in ranching brought about by scientific agriculture feedlots and custom feeding, modern range management.

7. Problems of Human Population:

Population distribution in different ecosystems, and different societies (with different technical skill), rate of growth of population. Relationship between man, his skills and natural resources. Rural land planning in developed and developing countries. Differences in interpretation of resources. Control of population size, dangers of over population.

Recommended Texts

1. Bert, R. (2006). *Infrastructure: the social value of shared resources*. New York: Oxford University Press.
2. Dunster, K. (2011). *Dictionary of natural resource management*. Amsterdam: UBC press.

Suggested Readings

1. Coutts, C. (2016). *Green infrastructure and public health*. London: Routledge.
2. Niles, E. (2003). *Life on earth: An encyclopedia of biodiversity, ecology, and evolution*. California:
   ABS-CLIO.
3. Burley, J. (2004). *Encyclopedia of forest sciences*. New Delhi: Academic Press.

GEOG -6170 **South Asia** **3(3+0)**

South Asia, which contains nearly a quarter of the world's people, refers to the countries comprising the South Asian subcontinent: Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, Maldives, and sometimes. The purpose to understand of the concentration is to provide cross-cultural interdisciplinary understanding of a complex civilization that is both ancient and modern, and of great significance in the contemporary world. In this course, interdisciplinary in scope, we will explore connections among religion, literature, social organization, and film in the formation of cultures in South Asia. The course will introduce representative themes and debates from a range of temporal, geographical, and social locations in South Asia and invite attention to their impact on the rest of the world.

Contents

1. Introduction and History of South Asia
2. Geo-political importance of south Asia
3. Mountain of South Asia
4. Plains
5. Deserts
6. River and Lakes
7. Coastal area
8. Plateau

9. Religion
10. Language
11. Culture
12. Agriculture (Irrigation system and crops)
13. Industries
14. Poverty of Gender
15. Forest Distribution
16. Minerals
17. Climate

Recommended Texts

1. Clothey, F. W. (2007). *Religion in India: A historical introduction*. New York: Routledge.
2. Yogendra, K., & Malik, A. (2009). *Government and politics in South Asia* (6th Ed.). Boulder: Col. Westview Press.

Suggested Readings

1. McCloud, D. G. (2018). *Southeast Asia: tradition and modernity in the contemporary world*. New York: Routledge.
2. Fred W. (2007). *Clothey, religion in India: a historical introduction.* Glasgow: Blacker & Sons Ltd.
3. Yogendra, K., & Malik, A. (2009). *Government and politics in South Asia*. Boulder: Col. Westview Press.

GEOGRAPHY

GEOG - 6201 **Geographic Thought (Ancient)** **3(3+0)**

This course surveys the major traditions of geographic thought from the early 20th century to present. Attending to both 'human' and 'physical' perspectives in the discipline - as well as those that blur the lines between the social and natural sciences - we will explore the changing, contested nature of geographic knowledge in terms of its situated, historical contexts and its numerous reformulations in contemporary practice. The development of geographic thought from Greek times to the present, the contradictions and shifting positions in the geographic perspective prior to the development of the scientific method, and the contributions of the Greeks, Romans and Moslems to the development of Geographic Thought. In so doing, the course provides students with the background for understanding their research in terms of the philosophies and methods, and the convergences and departures that constitute the intellectual history of the discipline in general, and Geography at Madison in particular.

Contents

1. Development of Geographic Thought through the History:
2. A general survey of the geographical work of Greeks and Romans.
3. Muslim contribution to Geographic Thought.
4. European Renaissance.
5. Geographic Thought in the Humboldt and Ritter era.

6. Ideas of Ratzel and Vidal de la Blache and their influence on European
7. American Geographic Thought.
8. Development of a Scientific Geography:
9. Scientific geographic approach as suggested by W.M. Davis
10. E.C. Semple
11. H.H. Barrows, and Carl O. Sauer.
12. The establishment of geographic paradigms, concepts, ideas, theories and laws, and methodology.
13. The development and use of quantitative techniques.
14. The Environmental Challenge:
15. Environment of Eco-Systems
16. The Global Environment
17. Environmental risks and uncertainties.

Recommended Texts

1. Dikshit R.K. (1998). *Geographical thought.* Upper Saddle River: Prentice Hall.
2. Ahmad, K.S. (2000). *Geography through the Ages.* Karachi: PGR.

Suggested Readings

1. Ayhew, S. (2008). *Geography*. London: Harmonds Worth.
2. Mitchel, B. (2000). *Geography and resources analysis*. New York: Norton & Company.
3. Tim, U. (1992). *The place of geography*. London: Longman.

GEOG - 6202 Economic Geography 3(3+0)

This course provides an introduction to economic geography. The course explores processes driving spatial patterns of economic activity at the global, national, regional, and local scales. Topic areas include economic globalization, spatial distribution of industrial sectors, multinational corporations, international trade, regional economic development, and illegal economic activities. The course looks at the development of the global marketplace in both the developed and the developing world. After the completion of this course student will be able to understand the significance of geographic concepts for socio-economic processes and the dynamics of the world economy, man's resource use and the pressure that population puts on the resource base.

Contents

1. Introduction
2. Evolution of world economic systems
3. Medieval feudal economics, economic impacts of colonialism. Modern world economic systems
4. Concept of natural resources and reserves
5. Human resource and its development
6. Classification of economic activities

7. Primary activities; gathering, hunting, herding, subsistence
8. Intensive and extensive farming, commercial grain farming
9. Livestock farming, dairying, mixed farming, plantation farming, lumbering, fishing and mining
10. Green revolution and its implications
11. Secondary activities: Industrial revolution and manufacturing industries
12. Tertiary activities
13. Quaternary and Quinary activities
14. Regional inequalities, sustainable development and poverty alleviation
15. Impacts of Globalization

Recommended Texts

1. Aoyama, Y., James T. M. & Susan H. (2012). *Key concepts in economic geography*. Singapore: SAGE.
2. Boyee, R. R. (2000). *The basic of economic geography*. New York: Holt, Rinehart & Winston.

Suggested Readings

1. Khan, F.K. (1998). *An introduction to economic Geography*. Karachi: Oxford Publishers.
2. Knox, P & Agnew, J. (2008). *The geography of the world economy*. London: Edward Arnold.
3. Alnwick, H. (2012). *A geography of commodities*. London: Harrap.

GEOG - 6203 **Geomorphology-I** **3(3+0)**

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mould the landscape. Landforms are produced by erosion or deposition, as rock and sediment is worn away by these earth-surface processes and transported and deposited to different localities. The different climatic environments produce different suites of landforms. The landforms of deserts, such as sand dunes and ergs, are a world apart from the glacial and per glacial features found in polar and sub-polar regions. So geomorphology is a diverse discipline. Although the basic geomorphologic principles can be applied to all environments, geomorphologists tend to specialize in one or two areas, such aeolian (desert) geomorphology, glacial and per glacial geomorphology, volcanic and tectonic geomorphology, and even planetary geomorphology. Most research is multi-disciplinary, combining the knowledge and perspectives from two contrasting disciplines, combining with subjects as diverse as ecology, geology, civil engineering, hydrology and soil science.

Contents

1. Introduction
2. Definition and Scope, Development of Science of Geomorphology
3. Muslims Contribution to the Science of Geomorphology
4. Models of Landform Development, Structural Landform
5. Weathering Landforms
6. Erosional Landforms, Depositional Landforms
7. Geomorphic Process:
8. Endogenetic Processes
9. Exogentic Processes
10. Extraterrestrial Processes
11. Weathering:
12. Physical Weathering
13. Chemical Weathering
14. Biological Weathering
15. Mass Wasting:
16. Slow Flowage Type
17. Rapid Flowage Type
18. Subsidence

Recommended Texts

1. Thompson, G. R., & Turk, J. (1998). *Introduction to physical geology*. Amsterdam: Brooks/Cole Publishing Company.
2. Thornbury, W. D. (2004). *Principles of geomorphology*. New York: John Willy & Sons.

Suggested Readings

1. Englen O.D.V. (2000). *Geomorphology*. New York: .Macmillan.
2. Stringer, E. T. (2004). *Modern Physical Geography*. New York: John Wiley & Sons.

GEOG - 6204 Climatology 3(3+0)

The course provides an overview of the physical processes responsible for determining global and regional climate. This course gives a general introduction to meteorology and climatology. Meteorology topics include energy balance, moisture and cloud development in the atmosphere, atmospheric dynamics, small and large scale circulations, storms and cyclones, and weather forecasting. Climatology topics include the interaction between the atmosphere and oceans over long time periods, climate classification, and the potential for climatic change. It brings together information from rural communities, indigenous peoples and research workers on how they use agro-biodiversity to cope with climate change. It stimulates communication between agro-biodiversity researchers, users and maintainers. It identifies tools and practices relevant to using agro-biodiversity for coping with climate change and making these widely available. It also promotes awareness of the vital role of agro-biodiversity in adapting to climate change among key audiences, including donors, development agents and the global biodiversity community

Contents

1. Development of the science of Climatology
2. Definition and Scope, study methods, climatic data, collection, presentation and analysis.
3. Elements and factors of climate, structure and composition of atmosphere, insulation, temperature, pressure and winds; air masses and fronts; precipitation, storms, cyclones, tornadoes and thunderstorm.
4. Classification of climates; a critical study of the Koppen, Miller and Thornthwaite classification of major climates
5. Climatic types; their characteristic features and geographical distribution.
6. Climatic changes and variability.
7. Principles of microclimatology and its application in Pakistan.
8. Applied Climatology and its application in Pakistan. Intentional weather modification.
9. Introduction to climate modelling, climate modelling and parameterization, atmospheric general circulation modelling, sensitivity experiments and applications. Future prospects.
10. Climate and climatic regions of Pakistan.

Recommended Texts

1. Miller A. (2001). *Climatology*. Haryana: Shubhi Publications.
2. Barry. R. (1998). *Atmosphere, weather and climate*. London: Routledge.

Suggested Readings

1. Shamshad, K.M. (1988). *The meteorology of Pakistan*. Karachi: Royal Book Co.
2. Strahler, A. N. (1998). *Elements of physical geography*. New York: John Wiley.
3. Diwan A. P. & Arora. D. K. (1995). *Origin of ocean*. New York: John Wiley.

GEOG - 6205 Quantitative Methods 3(3+0)

To train students in collection, analysis, interpretation and presentation of quantitative spatial data and to enable them to organize and conduct independent research. To use database software for the analysis of both Spatial and Temporal data. Quantitative techniques are the techniques that are concerned with collection, organization, presentation, analysis and interpretation of data. The quantitative techniques in geography are a recent development. The hard numbers behind any good research project are called quantitative data. Quantitative data is the language of science. It uses mathematical models, theories, and hypotheses. Quantitative data and qualitative data, in which you observe the non-numerical qualities of your subject, go hand-in-hand.

Contents

1. Introduction
2. Quantitative revolution and its impact on Geography
3. Parametric and non-parametric statistics
4. Nature of geographical data
5. Measurement scales.
6. Data summarizing techniques
7. Theory of central tendency
8. Dispersion, and variability.
9. Time Series: graphs, growth and decline, index numbers, logarithmic scales, trends and fluctuations, components of time series.
10. Methods of drawing trend lines for linear and exponential series scatter diagrams, standard errors and probability, correlation and regression.
11. Quantitative models in Geography

Lab. Work:

Introduction to EPI-Info SPSS E-view, MS Excel, MiniTab and other relevant software database for quantitative analysis.

Recommended Texts

1. Haring, L. L. (2002). *Introduction to scientific geographic research*. Oxford: ECB.
2. Levin, J. (2006). *Elementary statistics in social research.* New Delhi: Pearson.

Suggested Readings

1. Matthew, H., & Foster, I. (2001). *Geographical data. sources. presentation and analysis.* London: Oxford University Press.
2. Mckillup, S. & Melinda, D. D. (2010). *Geostatistics explained*. Cambridge: Cambridge University Press.
3. Walford, N. (2011). *Practical statistics for geographers and earth science.* Singapore: Wiley-Blackwell.

GEOG - 6206 Principles of Cartography 1(1+0)

Cartography or mapmaking is the study and practice of making representations of the Earth on a flat surface. The discipline of cartography combines science, aesthetics, and technical ability to create a balanced and readable representation that is capable of communicating information effectively and quickly. Cartography is a complex, an ever-changing field, but at the center of it is the map-making process. Viewed in the broadest sense, this process includes everything from the gathering, evaluation and processing of source data, through the intellectual and graphical design of the map, to the drawing and reproduction of the final document. As such, it is a unique mixture of science, art and technology and calls for a variety of in-depth knowledge and skills on the part of the cartographer.

Contents

1. Introduction, Introduction to Cartography
2. Nature of Cartography, History of Cartography
2. Basic Geodesy
3. Spherical, Ellipsoidal and Geoidal Earth, Geographical Coordinates, Properties of the Graticule, Geodetic position determination
4. Map Projections, Merits and demerits of commonly used Map Projections
5. Scale, Reference and Coordinate Systems, Map Scale
6. Reference Systems, Coordinate Systems, Datum
7. Cartographic Symbols, Symbol types and graphic variables, The symbolization
8. Mapping statistical surfaces
9. Lettering
10. Native of typography, Lettering methods
11. Types and type characteristics
12. Photo lettering and automatic Control lettering
13. Map Reading, Map Design
14. Basic procedure and designing of the following maps
15. Thematic, Topographic, Climatic, Economic, Population, Settlements, Urban Morphology
16. Map Production, Form of map output
17. Construction material, Output options
18. Composing separations

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. Karachi: Vikas Publishing House Pvt Ltd.
2. Singh. L. & Raghu naadam, S. (2000). *Map work and practical Geography*. New Delhi: kalyani publishers.

Suggested Readings

1. Ahmad. Z. (1998). *Text book of Practical geography*. Cambridge: Cambridge University Press.
2. Bygott, J. (2000). *An introduction to map work and practical geography*. University Tutorial Press.

GEOG - 6207 **Lab. Work** **2(0+2)**

A unique aspect of geography is that it exposes students to a wide range of techniques for helping to understand human and environmental patterns and processes. Mapmaking is the study and practice of making representations of the Earth on a flat surface. Viewed in the broadest sense, this process includes everything from the gathering, evaluation and processing of source data, through the intellectual and graphical design of the map, to the drawing and reproduction of the final document. As such, it is a unique mixture of science, art and technology and calls for a variety of in-depth knowledge and skills on the part of the cartographer

Contents

1. Advanced exercises on scales
2. Enlargement
3. Reduction of maps
4. Representation of Relief Advanced Exercises on Contouring, section drawing and
5. Indivisibility
6. Drawing of the following class of Projections:
7. Cylindrical
8. Conical
9. Conventional
10. Azimuthal (zenithal)
11. Perspective
12. Non perspective
13. Importance of maps as basis of Geographical studies, study of topographic maps
14. Record
15. Each student shall submit record of all the Practical Work one week before the commencement of the Practical examination. The work of the candidates shall be examined individually.

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. Karachi: Vikas Publishing House Pvt Ltd.
2. Singh. L. & Raghu naadam, S. (2000). *Map work and practical Geography*. New Delhi: kalyani publishers.

Suggested Readings

1. Ahmad. Z. (1998). *Text book of Practical geography*. Cambridge: Cambridge University Press.
2. Bygott, J. (2000). *An introduction to mapwork and practical geography*. University Tutorial Press.
3. Bygott, J. (2000). *Mapwork and practical geography*. New Dehli:University Tutorial Press.

GEOG - 6208 Geographic Thought (Modern) 3(3+0)

This course surveys the major traditions of geographic thought from the early 20th century to the present. Attending to both 'human' and 'physical' perspectives in the discipline - as well as those that blur the lines between the social and natural sciences - we will explore the changing, contested nature of geographic knowledge in terms of its situated, historical contexts and its numerous reformulations in contemporary practice. The development of geographic thought from Greek times to the present, the contradictions and shifting positions in the geographic perspective prior to the development of the scientific method, and the contributions of the Greeks, Romans and Moslems to the development of Geographic Thought. . In so doing, the course provides students with the background for understanding their research in terms of the philosophies and methods, and the convergences and departures that constitute the intellectual history of the discipline in general, and Geography at Madison in particular.

Contents

1. Human Ecological Response
2. The Human Population
3. Resources and conservation
4. Our role in changing the face of the earth
5. Cultural fission: towards regional divergence
6. Regional Mosaic, Cultural Fission: Toward Regional Divergence
7. World Cultural Regions: The Emerging Mosaic
8. Spatial diffusion: Toward regional convergence
9. The Area-analysis Tradition in Geography
10. Urbanization: Origin Pattern and Factors of Urbanization
11. City Chains and hierarchies
12. Territories and boundaries
13. Rich countries and poor
14. Inequalities within countries
15. Future Tasks in Geography, Frontiers in Space and time
16. On going further in Geography , Geography and Planning
17. New Directions in Geography

Recommended Texts

1. Dikshit R.K. (1998). *Geographical thought*. Upper Saddle River: Prentice Hall.
2. Ahmad, K.S. (2000). *Geography through the Ages.* Karachi: PGR.

Suggested Readings

1. Ayhew, S. (2008). *Geography*. London: Harmonds Worth.
2. Mitchel, B. (2000). *Geography and resources analysis*. New York: Norton & Company.
3. Tim, U. (1992). *The place of geography*. London: Longman.

GEOG - 6209 **Commercial Geography** **3(3+0)**

This course has been designed particularly for those students of commercial geography with its bases regarding commercial activities in different environments, referring to world resources in general and Pakistan in particular. The course explore meaning and scope of the subject matter, basis of Commercial activities, the location and resources of Pakistan, provide a knowledge of Agricultural Production and their distribution, provide the knowledge of the production of important Minerals and their Distribution, know about major industries and their distribution in Pakistan, familiar the students with means of Transportation and Communication and their significance, provide a knowledge of the cities and ports as the centers of commercial activities, acquaint the students with the importance and significance of Trade and Commerce, provide an understanding of the role of Commercial Geography in promoting National integration and International understanding.

Contents

1. Conditions of Agriculture
2. The Physical Constraints on Agriculture
3. Agricultural Systems
4. Problem and Policies in Agriculture
5. The Economic Status of Farmer Scarcity and Abundance
6. Types of Agriculture and their Distribution
7. The Roles of Selected Commodities (Wheat, Rice, Sugarcane, Cotton, etc.)
8. Economic Factors in Mining
9. Metalliferous Minerals
10. Mineralized Regions
11. The Size of the Reserves
12. The Non-metalliferous Minerals
13. The Solid Fuels
14. Oil and Natural Gas
15. Industrial Location Theory
16. Factors of Industrial Location
17. Locational Analysis of Selected Industries
18. Industrial Regions
19. Characteristics of Transport System (Networks, Modes of Transport)
20. International Trade and Specialization

Recommended Texts

1. Aoyama, Y., James T. M. & Susan H. (2012). *Key concepts in economic geography*. Singapore: SAGE.
2. Boyee, R. R. (2000). *The basic of economic geography*. New York: Holt, Rinehart & Winston.

Suggested Readings

1. Khan, F.K. (1998). *An introduction to economic Geography*. Karachi: Oxford Publishers.
2. Knox, P & Agnew, J. (2008). *The geography of the world economy*. London: Edward Arnold.
3. Alnwick, H. (2012). *A geography of commodities*. London: Harrap.

GEOG - 6210 **Geomorphology II** **3(3+0)**

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mold the landscape. It helps to understand why landscapes look the way they do, to understand landform history and dynamics and to predict changes through a combination of field observations, physical experiments and numerical modeling. Geomorphologists work within disciplines such as physical geography, geology, geodesy, engineering geology, archaeology and geotechnical engineering. This broad base of interests contributes to many research styles and interests within the field.

Contents

1. Glacier
2. Genesis and Motion
3. Classification, Nourishment and Wastage
4. Erosional and Deposition Landforms
5. Fluvial Processes, Fluvial Cycle
6. Rejuvenation
7. Idealised Fluvial Cycle
8. Complications of the Field Cycle
9. Drainage Pattern
10. Arid Cycle and Aeolian Landforms:
11. Forms of Wind Erosion
12. Wind Transportation
13. Wind Deposition
14. Karst Topography, Development of Karst Landscape, Characteristic of Karst Features
15. Quantitative Geomorphology
16. Methods of Geomorphological Investigation
17. Morphometric Analysis
18. Material Properties
19. Process and Evolution
20. GIS and RS Applications
21. Data Acquisition
22. Digital Terrain Modelling
23. Feature Extraction

Recommended Texts

1. Thompson, G. R., & Turk, J. (1998). *Introduction to physical geology*. Brooks/Cole Publishing Company.
2. Thornbury, W. D. (2004). Principles of geomorphology. New York: John Willy & Sons.

Suggested Readings

1. Englen O.D.V. (2000). *Geomorphology*. New York: Macmillan.
2. Stringer, E. T. (2004). *Modern physical geography*. New York: John Wiley & Sons.

GEOG - 6211 **Oceanography** **3(3+0)**

It describes knowledge about world's oceans their distribution, and its resources. To produce THE students with the applicable knowledge about existence of oceans, formation of ocean floors, their distribution and effects of climate and ocean resource management. It may identify the impact of basic and applied knowledge of oceanography, to impart skills on the ocean distribution, existence of oceans, and availability of resources in oceans. It discusses the spatial distribution of oceans and their effects Land, Ocean and atmosphere relationship, to study ocean currents, variability, and Mechanism. It will also discuss the law of sea and country rights for associated oceans and seas. It will discuss the ocean habitat to study the ocean resources and law of ocean territory.

Contents

1. Introduction to Oceanography, Origin and Structure of Ocean Basins
2. Origin of ocean basins, the permanency of the ocean basins and related theories.
3. The origin of ocean water.
4. Changes in sea level during the Tertiary and Quaternary periods.
5. The Floors of Oceans, the physiography of the ocean floor.
6. Geologic differences between continents & ocean basins.
7. Characteristic features of ocean basins.
8. Marine sedimentation.
9. The Circulation of the Oceans, ocean Currents, waves and tides.
10. Oceanic storms and disturbances.
11. The Ocean Resources:
12. Law of the sea.
13. Mineral Resources, Biological Resources.
14. The Geographical Significance of the Oceans
15. Interaction of ocean and atmosphere.
16. The changing sea level.
17. Oceans in exploration and transport.
18. The strategic role of oceans.
19. Oceans and Seas of the World

Recommended Texts

1. Douglas A. Segar. (1998). *Ocean sciences.* Boston: Wadsworth publishing Company.
2. Barnes, H. (2000). *Apparatus & methods of oceanography*. London: George Allen & Unwin Ltd.

Suggested Readings

1. Duxbury, A.B & Duxbury, A.C. (1994). *An introduction to the world oceans.* Oxford: WMC Brown Publishers.
2. King, C.A.M. (2000). *Oceanography for Geographers*. London: Edward Arnold Publishers, Ltd.

GEOG - 6212 Research Methods 3(3+0)

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Each research study has its own specific purpose, we may think of research objectives are: to create awareness among students regarding basics of geographical research. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulated research studies); To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies); To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies); To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

Contents

1. Introduction Research approaches
2. Research paradigms in Geography
3. Types of research: historical research, qualitative/descriptive research, quantitative/experimental research
4. Research design; research topic, formulation and statement of a problem, research questions, research hypotheses, research objectives, research plan
5. Literature review; Literature sources: Journals (types) Books, Monographs and web sources
6. Data collection, universe and sampling: primary and secondary data, sources of data
7. Selection of a sample and measuring instruments, basic considerations in sampling, size of sample, geo-statistical
8. considerations, Sampling units and design; points, traverses, random sampling, stratified sampling, systematic sampling
9. Field Techniques
10. Data analysis and interpretation: pre-analysis considerations,
11. Preparing data for analysis: use of the descriptive statistics and quantitative methods.
12. Data presentation
13. Research report writing; Proposal and Synopsis writing
14. Bibliography and references

Recommended Texts

1. Therese, L. B. (1999). *Doing social research*. Boston: McGraw Hill.
2. Nicholas J. Clifford & Gill V. (2003). *Key methods in geography*. London: Sye Publications.

Suggested Readings

1. Keith Hoggart, Loretta Lees & Anna Davies (2002). *Researching human geography*. London: Arnold Publishers.
2. Dr. K. L. Narasimha Murthy (1992). *Research in geography: a survey*. New Delhi: Ashish Publishing House.
3. John W. Best & James V. Kahn, (2003). *Research in education*. New Dehli: Prentice Hall Private Ltd.

GEOG - 6213 **Surveying** **3(1+2)**

Surveying is the science of measuring and recording distances, angles, heights and sizes on the earth's surface to obtain data from which accurate plans and maps is made. It is the art and science of determining the position of natural and artificial features on, above the earth's surface or establishing such point and representing this information on paper plans, as figures, tables or computer based map. The basic concerns regarding a survey are spaces and locations within them. Survey essentially takes note of specific point locations for later reference. Surveying has been essential elements in the planning and execution of nearly every form of construction. One of the main functions of surveying is to acquire data on the shape and position of features on the ground, and to somehow delineate this information on maps, plans and drawings so as to make this data useful for other observers/users. These maps and plans can range from simple drawings in terms of sketches through to plans and maps, all based on some fundamentals of graphical communication

Contents

1. Plane Table Surveying
2. Compass Survey: General description, bearing, compass traverses (open and close). Calculation of included angles – calculated bearings plotting from the true north - adjustment of errors-compass sketch surveys-fixing new station-combined traverses and sketch surveys.
3. Levelling: General description kinds of levels, adjustments in levels-contours by clinometer-Tangent scale clinometers use with Plane Table laying out of contours – leveling, procedure of leveling, methods of calculating reduced levels. Profiles, longitudinal leveling, cross sectional leveling- accuracy required in leveling operation. Advantage and source of errors in leveling procedure.
4. Triangulation Surveys: Theodolite: Types of Theodolites, parts of Theodolite, use of Theodolite, adjustments of the instrument. Measurement of horizontal and vertical angles. Measurement of base line. Triangulation surveys. Filling in of detailing with plane-table in triangulation surveys. Finding out height of inaccessible objects.
5. GPS Surveying: Introduction, Types of GPS, Performance and Errors, Techniques and Use & Applications

Recommended Texts

1. Singh, G. (2009). *Map work and practical geography*. New Delhi: Vikas Publishing House Pvt. Ltd.
2. Singh, L. & Raghu, N. S. (2000) *Map work and practical geography*. New Delhi: Kalyani publishers.

Suggested Readings

1. Khan, M. Z. A. (1998). *Text Book of Practical Geography*. Delhi: Concept Publishing Company.
2. Bygott, J. (1952). *An introduction to mapwork and practical geography*. London: University Tutorial Press.
3. Bygott, J. (1955). *Mapwork and practical geography*. London: University Tutorial Press.

GEOG - 6214 Population Geography 3(3+0)

This course introduces population geography to advanced undergraduate students, and graduate students. We will examine how and why aspects of population have been understood as 'problems' in different and times. he syllabus coverts the major concepts and basic tools of demography; key geographical and historical processes of population change such as fertility, mortality and migration; and the socio-economic, political, and environmental causes and consequences of population dynamics in different world regions and over time. The population dynamics are discussed in a way that incorporates economic, political, cultural and environmental issues. To develop this critical geographic approach to population issues, we will places examine trends in population, population patterns at several scales (global, national, urban) and the population processes (fertility, mortality, migration) that create them. Further, we will investigate how population processes are shaped by, and engender, larger processes of political, environmental, urban, economic, and cultural change.

Contents

1. Introduction
2. Population theories
3. Sources and methods of population data collection and associated problems
4. Population distribution and density
5. Urban and rural population
6. Population composition
7. Gender composition, age structure, marital status, families and households, languages, religions, ethnic groups etc.
8. Population dynamics
9. Patterns of fecundity and fertility
10. Morbidity and mortality
11. Migration and its types
12. Demographic transition
13. Population growth and change
14. Population Projections

Lab. Work:
Consultation of the Population Census of Pakistan and representation of population data on maps.

Recommended Texts

1. Newbold, K. B. (2017). *Population geography: tools and issues*. Toronto: Rowman & Littlefield.
2. Ardagh, M. (2013).*Textbook of population geography.* New Delhi: Random Exports.

Suggested Readings

1. John. I. C. (1997). *Population geography*. Toronto: Rowman & Littlefield.
2. Majid, H. (1994). *Population geography.* Karachi: Anmol Publications
3. Polunin, N. (1998). *Population and global security.* Cambridge: Cambridge

GEOG - 6215 Remote Sensing 3(2+1)

It describes about knowledge of Remote Sensing (RS) and its practical implementation. To produce students, that has applicable knowledge about basic tools of GIS. The course aims to equip students with an understanding of GIS, evolution and applications of spatial data through Geo-spatial technologies. Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area. Special cameras collect remotely sensed images of the Earth, which help researchers "sense" things about the Earth. It introduces knowledge of recording earth's surface features from space-borne platforms and different ways in which images can be analyzed. It will enable students to develop an understanding of common remote sensing products such as, earth resources satellite images, aerial photographs etc to develop a comprehension regarding ground-truthing aided by GPS.

Contents

1. Introduction
2. History and Development
3. Concepts and Foundation of Remote Sensing and Electromagnetic spectrum
4. Visible Spectrum, Colour Theory
5. Atmospheric Attenuation
6. Types of Remote Sensing Systems
7. Type of Sensors
8. RBV, MSS, TM,HRV, HRPT/APT/AVHRR, MODIS (Terra and Aqua) non-imaging systems (RADAR)
9. Types of Satellites
10. Telecommunication, Spy, Scientific etc.)
11. Platforms (Orbits)
12. Ground Receiving Stations (Reception of Data)
13. Image Processing
14. Global Positioning System (GPS)
15. Applications of Remote Sensing
16. Remote Sensing in Pakistan: Potential and Prospects.

Recommended Texts

1. ITC (2004). *Principles of remote sensing.* Netherlands: ITC Educational Textbook Series.
2. Campbell, J. B. & Wynne, R. H. (2011). *Introduction to remote sensing*. New York: Guilford Press.

Suggested Readings

1. Iliffe, J. & Lott, R. (2008). *Datums and Map Projections for remote sensing, GIS, and Surveying*. Second Ed.. Manchester: Whittles Publishing.
2. Jensen, J. (2005). *Introductory remote sensing*: *Principles and Concepts*. New York: Freeman & Co.
3. Jensen, J. R. (2011). *Remote sensing of the environment: an earth resource perspective*. New Jersey: Prentice Hall.

GEOG - 6216 Geographical Information System 3(2+1)

The course aims to equip students with an understanding of GIS, evolution and applications of spatial data. In this class, students will be introduced to the study and design of maps, primarily through the application of a specialized computer mapping software program known as a Geographic Information System (GIS). GIS is a map-based computer decision support system that allows for the investigation of geographic data relationships. People that are trained in GIS are in high demand today, both in government and private industry. The lecture sessions in this class will focus primarily on GIS-based mapmaking techniques, including map design, symbology, map coordinates and georeferencing systems. Students will cover many important aspects of mapmaking, including map data collection and processing, field methods and GPS, cartographic communication, topographic map reading and analysis, and qualitative and quantitative mapping techniques.

Contents

1. Introduction
   Definitions, key components, functional subsystem, Raster data model, vector data model, attribute model, Data acquisition techniques, data sources, data capturing techniques and procedures, data visualization of spatial data, layers, projections and transformation and datum.
2. Map design
   Symbols to portray points, lines, polygons and volumes, graphic variables, visual hierarchy, Data classification graphic approach, mathematical approach.
3. Spatial analysis
   Neighborhood functions, network, and overlay analysis, buffering, spatial data quality, components of data quality, micro level components, macro level components, usage components, sources of errors, accuracy and resolution and uncertainty.
4. GIS Applications

Lab. Work

Introduction to GIS Lab (hardware/ software), Raster/ Vector/ Attribute Data Display, Scanning, Digitization, coordinate based point mapping, Raster/ Vector Conversion,

Recommended Texts

1. Chang, K.. (2006). *Introduction to geographic information systems*. Boston: McGraw-Hill Higher Education.
2. Demers, M.N. (2002). *Fundamentals of geographic information systems*. New York: John Wiley & Sons.

Suggested Readings

1. Yeung., Lo, C.P. & Lal, A. K. (2003). *Concepts and techniques of geographic information system.* New Dehli: Prentice Hall.
2. Kiser, J.D., & Paine, D.P., (2003). *Aerial photography and image interpretation*, New York: John Wiley & Sons.
4. Janssen, L. L., &Huurneman, G. (2000). *Principles of remote sensing*: ITC, International

Institute for Aerospace Survey and Earth Sciences.

GEOG - 6217 Pakistan (Environment & Economy) 3(3+0)

Pakistan Geography is a vital topic for study because it allows a student to understand the planet in a way that clarifies various global political issues and to see the relationship between people, groups and the physical environment in which they live. Geography gives us information about various types of climates, natural conditions, mineral wealth etc. of the various nations. As the world becomes more interrelated and interdependent through technological advances, it is increasingly important to understand the physical and cultural differences of other places. Studying of Pakistan geography also opens a link to understanding the history of one's own culture, as well as that of others. An understanding of geography also allows one to make smart choices when dealing with issues regarding the relationship of society to the physical environment.

Contents

1. Geo-strategic position of Pakistan
2. Location and Geographical significance
3. Geo political importance, 4. Administrative setup
5. Land and physical environment
6. Physiography, 7. Climate and Climate region
8. Soils and vegetation
9. Population characteristics: Structure: Composition and distribution
10. Population Change
11. Urbanization
12. Economy
13. Agriculture (crops and livestock)
14. Irrigation
15. Power and mineral resources
16. Industries
17. Trade
18. Tourism
19. Transport and communication
20. Major challenges of Pakistan

Recommended Texts

1. Khan, F. K. (2015). *Geography of Pakistan.* Karachi: Oxford University Press.
2. Ahmad, K. S. (2000). *Geography of Pakistan.* Karachi: Oxford University Press.

Suggested Readings

1. Burkey, J. S. (1991). *Pakistan the continuing search for nationhood.* Oxford: Western Press Oxford.
2. Davidson, A. P. & Ahmad, M. (2003). *Privatization and the crisis of agricultural extension: the case of pakistan, king's soas studies in development geography.* New Delhi: Ashgate Publishing.

GEOG - 6222 **Political Geography** **3(3+0)**

Political geography is concerned with the study of both the spatially uneven outcomes of political processes and the ways in which political processes are themselves affected by spatial structures. In this course, we will survey Political Geography, a subfield of Human Geography which focuses on questions of space and power and the interconnections of geography and politics. All politics are geographical, from the spatial arrangement of local governments to the territorial basis of international trade. We will explore how politics works with a concern for where political impacts occur at a variety of geographical scales (from the international to the local) while also considering how geographical factors impact political actions. We'll also examine the geography of various formal institutions and practices of politics as well as the informal politics of everyday life within places. In short, we'll explore how political power makes geographies and how, in turn, geography may be said to make politics.

Contents

1. Nature and objectives of Political Geography, Definition and development of political geographic thought.
2. A critical examination of the following:
3. Concept of environmental relationship in political geography.
4. The concept of geopolitics its development and short-comings
5. National deterministic theories of Germans and French possibilities.
6. State as a Politico-geographic Phenomenon:
7. Concept of the state and its classification. Chief political-geographic characteristics of states.
8. Hierarchy of political area.
9. Frontiers and boundaries: their concepts, functions and classification.
10. Core areas, ecumenical area and capitals.
11. Approaches and forces in the politico geographic study of state:
12. A critical examination of the following approaches:
13. Simple descriptive approach, Historical approach.

Recommended Texts

1. Jones, M., Jones, R., Woods, M., Whitehead, M., Dixon, D., & Hannah, M. (2014). *An introduction to political geography: space, place and politics*. London: Routledge.
2. Kruys, B. G. G. (2002). Controlling land borders: A comparison of the United States of America, Germany and South Africa. *Strategic Review for Southern Africa*, *24*(2), 114.

Suggested Readings

1. Agnew, J. (1997). *Political geography: a reader*. London: Arnold .
2. Bakis, H. (1995). Communication and Political Geography in a Changing World. *Revue Internationale de Science Politique 16*(3). 219–311.
3. Vaughan-Williams, N. (2009). *Border Politics: The Limits of Sovereign Power: The Limits of Sovereign Power*. Edinburgh: Edinburgh University Press.

GEOG - 6223 **Conservation of Resources** **3(3+0)**

Natural resources conservation workers strive to protect natural resources, such as water, soils, minerals, forests and wildlife. Studies in natural resources conservation are multidisciplinary, covering topics in resource management, recreation, development and ecosystems. Conservation includes both the protection and rational use of natural resources. Earth's natural resources are either nonrenewable, such as minerals, oil, gas, and coal, or renewable, such as water, timber, fisheries, and agricultural crops. We need to conserve our Natural Resources because it is the main source of our daily needs. We need to conserve it because they are limited only. And if these resources are abused and harmed, we will have short quantity of sources for food and living. Remember our future generation will need also our Natural Resources.

Contents

1. Scope of the subject; its importance, problems created by the expanding population; advancing technology, increasing standings of living and greater demand for space and goods thereof. Relation of subject to other disciplines.
2. Agricultural Resources:

Agriculture and man. Types of agriculture, agricultural land use and cropping pattern. Efficiency of agriculture, problems relating to agricultural land. Agricultural regions of the work.

3. Animal Resources:

Ranching and pasture, problems of overgrazing, carrying capacity of land, recent changes in ranching brought about by scientific agriculture feedlots and custom feeding, modern range management.

4. Problems of Human Population:

Population distribution in different ecosystems, and different societies (with different technical skill), rate of growth of population. Relationship between man, his skills and natural resources. Rural land planning in developed and developing countries. Differences in interpretation of resources. Control of population size, dangers of over population.

Recommended Texts

1. Bert, R. (2006). *Infrastructure: the social value of shared resources*. New York: Oxford University Press.
2. Dunster, K. (2011). *Dictionary of natural resource management*. Amsterdam: UBC press.

Suggested Readings

1. Coutts, C. (2016). *Green infrastructure and public health*. London: Routledge.
2. Niles, E. (2003). *Life on earth: An encyclopedia of biodiversity, ecology, and evolution*. California:
   ABS-CLIO.
3. Burley, J. (2004). *Encyclopedia of forest sciences*. New Dehli: Academic Press.

GEOG - 6224 Hydro Geography 3(3+0)

It describes advanced knowledge about Water resources, water resource management, Hydrology, distribution and availability of water. This course provides a basic introduction to hydrologic processes, including fundamentals of hydrology, rainfall-runoff modeling, hydraulic processes (including both pressurized pipe flow and open channel flow), and hydrologic frequency analysis. These fundamentals are then applied in the computation of design flows and in the analysis and design of hydraulic systems such as pipe networks and storm water management systems. Computational laboratory sessions (including geographic information systems and simulation models) and experimental laboratory sessions reinforce lectures and provide hands-on learning opportunities. By the end of this course, students should be able to apply standard techniques, computational tools, and data used by engineers in conducting hydrologic analysis.

Contents

1. Introduction
2. Hydrological Cycle and Water Balance: Water Reservoirs, Hydrological Cycle, Water Balance
3. Precipitation and Rainfall
4. Runoff: Factor affecting the Runoff, Runoff Cycle and Phases of Runoff, Measurement of Runoff
5. Ground Water
6. Floods: Causes and Seasonal Distribution of Floods, Flood Protection and Planning, Geographical Distribution of Floods
7. Glacial Water: Glacial Nourishment and Wattage, Glacial Runoff, Glacial Flow, Response of Glacier to Climatic Changes
8. Droughts: Extent and Distribution of Droughts, Drought Severity, Frequency and Duration, Hydrological Relations in Draughts
9. Lakes: Origin and Diversity, Hydrological Cycle and Water Balance Lakes, Geographical Distribution
10. Water Pollution: Classification of Water Pollutants, Extent and Distribution of Water Pollutants, Effects of Water Pollution on Fauna and Flora
11. Quantitative Hydro Geography: Basis Concepts, Areal Aspects of Drainage Basins
12. GIS and RS Application:

Recommended Texts

1. Raghunath, H. M. (2006). *Hydrology: principles, analysis and design*. Amsterdam: New Age International.
2. Ward, R.C. & Robinson, M. (2000). *Principles of hydrology*. London: McGraw Hill.

Suggested Readings

1. Bittinger, M. W. (2000). *Water resources, use, and management.* Proceedings of a symposium held at Canberra. Edwin S. (Hill, Eds). Cambridge: Cambridge University Press.
2. Meinzer, O.E. (2000). *Hydrology.* New York: McGraw Hill.
3. Chow, V. T. (2000). *A handbook of applied hydrology.* New York: McGraw Hill.

GEOG - 6229 Regional Planning & Development 3(3+0)

Regional planning deals with the efficient placement of land-use activities, infrastructure, and settlement growth across a larger area of land than an individual city or town. This course will explore and analyze the various aspects, concepts and approaches of urban geography. The course will cover topics such as historic and contemporary urban development; spatial dimensions of the city; social and economic patterns; images of the city; inequality and the development of urban built environment. Regional planning is a sub-field of urban planning as it relates land use practices on a broader scale. It also includes formulating laws that will guide the efficient planning and management of such said regions. Regions require various land uses; protection of farmland, cities, industrial space, transportation hubs and infrastructure, military bases, and wilderness. Regional planning is the science of efficient placement of infrastructure and zoning for the sustainable growth of a region.

Contents

1. Principles and Scope of Planning and Development
2. Planning: A Geographer's View, ii. Planning Processes
3. Planning as an Activity
4. Objectives in Planning
5. Objectives of Regional Development Efforts.
6. Implications of Regional Development:
7. Defining Regions
8. Resources and Planning:
9. The Resource Base, Resource Evaluation.
10. Utilization of Resources for Planning and Development.
11. Urban and Regional Planning, Urban Growth Patterns.
12. Impact of Industrialization.
13. Planning for Cities and City Regions.
14. Rural Planning:
15. Agricultural Planning and Rural Development.
16. The Human Factor in Agricultural Development.
17. Examples of Urban/Rural/Regional Planning with Special Reference to Pakistan:

Recommended Texts

1. Hall, P. (2000). *Urban and regional planning* (2nd ed.). London: Allen & Unwin.
2. Hudson, R. & Lewis J.R. (2000). *Regional planning in Europe*. London: Pion Ltd.

Suggested Readings

1. Birmingham, W., & Ford, A.G., (2000). *Planning and growth in rich and poor countries.* London: George Allen and Unwin Ltd.
2. Cox, K. R. (2000). *Location and public problems.* Oxford: Basil Black-Well.
3. Frey H. (1999). *Designing the city towards a more sustainable Urban Form*. London: Routledge.

GEOG - 6232 Agricultural Geography 3(3+0)

Agricultural geography is a sub-discipline of human geography concerned with the spatial relationships found between agriculture and humans. Agricultural Geography provides the basic information of various types of the agriculture on the earth surface viz., Subsistence, commercial, horticulture, specialised etc. Agricultural Geography as a sub-discipline of human and economic geography. The geography of human activities is called as 'economic geography' which examines the primary, secondary, tertiary and quaternary activities of man. Man in his primeval stage was a hunter and gather and during the Neolithic period he learned the art of cultivation of crops. Thus, agriculture had been the dominant economic activity in the past and it is still the mainstay of over two-third of the world population. The study of agricultural geography is thus of great social relevance among all the branches of human geography.

Contents

1. Introduction to agricultural geography:
2. Nature and scope
3. The origins and development of agriculture
4. Theoretical aspects of geographical location relevant to agriculture
5. Approaches to the study of agriculture in geography:
6. Introduction
7. Approaches: commodity, regional, deterministic, systematic
8. Factors influencing agricultural patterns:
9. Physical factors: the terrain, climate, soil, water resources
10. Socio-economic factors: technological, population, cultural, infrastructure
11. Land, labour and capital
12. Government and regional policies
13. The nature and need of models
14. Classification of models
15. Models of agricultural activity
16. Agricultural regions: concepts and techniques:
17. Concept and methodology
18. Techniques: normative, empirical, single element, statistical

Recommended Texts

1. Newbury, P. A. R. (1999). *Agricultural geography*. London: Longman.
2. Shukla, L. (2011). *Readings in agricultural geography.* Jaipur: Scientific Publisher.

Suggested Readings

1. Laingen, C. & Harrington, L (2013). *Agricultural geography*. Oxford: Oxford University Press. DOI 10.1093/OBO/9780199874002-006
2. Bowler, I. R. (1992) *The industrialization of Agriculture*. In Bowler I. R. (ed).
3. Singh, J. & Dhillon, S. S. (2000). *Agricultural geography*. New Delhi: McGraw-Hill.

GEOG - 6233 Geography of Manufacturing 3(3+0)

The term "manufacturing" includes those activities by which man changes the form or nature of raw materials, converting them into more useful products. The course focuses on explanations of factory location, the role of location in corporate strategies and the geographical structure of production systems, including industrial districts. Particular attention is paid to the organizational structure of the economy, especially the dominant role played by multinational firms (MNCs), and the forces that shape the agglomeration and dispersal of activity. These transforming operations are conducted in factories, to which are brought raw materials from various source regions and from which go finished products to diverse market regions. Factories which characterize industrial regions may be interrelated: some may supply semi-finished items to other factories; others may be branch plants; and still others may have a service relationship, such as a power plant, which supplies electrical energy to other factories. A relationship also exists between factories and non-factory elements.

Contents

1. Introduction to Geography of Manufacturing:
2. Definitions and concepts, and organization.
3. Classification of industrial activities.
4. Historical Development of Industrial Activity:
5. From industrial revolution to green paradigm.
6. Modern trends in manufacturing.
7. Industrial Location:
8. Approaches to location dynamics.
9. Location factors.
10. Location models.
11. Location theories.
12. Geographical Analysis of Selected Industries:
13. Light industries (Cotton textiles, sugar industry)
14. Heavy industries (Iron and steel, petro-chemicals, cement)
15. Modern Issues in Manufacturing:
16. Patterns of international production and the industrialization process.
17. De industrialization.
18. Industry and environmental problems.
19. Industrial planning and management.

Recommended Texts

1. Alexanderson, G. (2000). *Geography of Manufacturing*. Englewood Cliffs: Prentice Hall Publications.
2. Altaf, Z. (2000). *Entrepreneurship in the Third World Risk and Uncertainty in Industry in Pakistan.* London: Croom Helm Ltd.

Suggested Readings

1. Chapman, K. & Walker, D.F. (1991). *Industrial Location*, 2nd ed.. Oxford: Wiley Eastern Ltd.
2. Emery, J.S. & Shaw, J.H. (2000). *Cities and Industries*. Milton: Jacaranda Press.
3. Hayter, R. (2000). *The Dynamics of Industrial Location.* New York: John Wiley & Sons.

GEOG - 6235 Medical Geography 3(3+0)

Medical geography is an important "new" area of health research that is a hybrid between geography and medicine dealing with the geographic aspects of health and healthcare. Medical geography studies the effects of locale and climate upon health. It aims to improve the understanding of the various factors which affect the health of populations and hence individuals. It is also called health geographics. Focuses on the design of GIS-based models to address health and healthcare issues. Topics include a conceptual framework, landscape epidemiology models, disease diffusion models, health accessibility, human health behavior and location-allocation of health services. Laboratory section provides hands-on experience applying these models with GIS tools.

Contents

1. Introduction to Medical Geography:
2. Definitions, themes, concepts
3. Nature & scope of Medical Geography
4. The Historical Development of Medical Geography
5. The status of Medical Geography.
6. Factors inflecting the Patterns of Health & Disease:
7. Geographical Factors.
8. Physical Factors
9. Environmental Factors.
10. Cultural Factors.
11. Socio – Economic & Political Factors.
12. Patterns & Processes of Health & Disease:
13. Spatial variations in health & welfare patterns.
14. Role of Geography in exploring the impacts of diseases.
15. Models in Medical Geography
16. Epidemiological Transition
17. Health & inequalities
18. Inverse care law.
19. Global Patterns of health & Disease.
20. Global Eradication of disease.
21. Progress in Medical Geography:

Recommended Texts

1. Lloyd, J. (2002). *Health & welfar*e. London: Holder & Stoughton.
2. Izhar, F. (2004). *Geography & health: a study in medical geography*. New Delhi: A.P.H. Publishing Corporation.

Suggested Readings

1. Leninan, J. & Fletcher, W.W. (2000). *Health & the environment*. Glasgow: Blacker & Sons Ltd.
2. Lloyd, J. (2002). *Health & welfare. London:* Holder & Stoughton.

GEOG - 6240 **South Asia** **3(3+0)**

South Asia, which contains nearly a quarter of the world's people, refers to the countries comprising the South Asian subcontinent: Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, Maldives, and sometimes. The purpose to understand of the concentration is to provide cross-cultural interdisciplinary understanding of a complex civilization that is both ancient and modern, and of great significance in the contemporary world. In this course, interdisciplinary in scope, we will explore connections among religion, literature, social organization, and film in the formation of cultures in South Asia. The course will introduce representative themes and debates from a range of temporal, geographical, and social locations in South Asia and invite attention to their impact on the rest of the world.

Contents

1. Introduction and History of South Asia
2. Geo-political importance of south Asia
3. Mountain of South Asia
4. Plains
5. Deserts
6. River and Lakes
7. Coastal area
8. Plateau
9. Mid Term week
10. Religion
11. Language
12. Culture
13. Agriculture (Irrigation system and crops)
14. Industries
15. Poverty of Gender
16. Forest Distribution
17. Minerals
18. Climate

Recommended Texts

1. Clothey, F. W. (2007). *Religion in India: A historical introduction*. New York: Routledge.
2. Yogendra, K., & Malik, A. (2009). *Government and politics in South Asia* (6th Ed.). Boulder: Col. Westview Press.

Suggested Readings

1. McCloud, D. G. (2018). *Southeast Asia: tradition and modernity in the contemporary world*. New York: Routledge.
2. Fred W. (2007). *Clothey, religion in India: a historical introduction.* Glasgow: Blacker & Sons Ltd.
3. Yogendra, K., & Malik, A. (2009). *Government and politics in South Asia*. Boulder: Col. Westview Press.

MS
GEOLOGY

GEOL - 7104 Tectonics 3(3+0)

Plate tectonics is a relatively new theory that has revolutionized the way geologists think about the Earth. According to the theory, the surface of the Earth is broken into large plates. The size and position of these plates change over time. The edges of these plates, where they move against each other, are sites of intense geologic activity, such as earthquakes, volcanoes, and mountain building. Plate tectonics is a combination of two earlier ideas, continental drift and sea-floor spreading. So the following course enable students to understand about plates movements and sea floor spreading. This course will develop knowledge of the Earth as a four-dimensional dynamic system. The megascopic structure of the earth - oceanic and continental crust and lithosphere, and the asthenosphere, will be introduced and compared. The concepts of rifting and ocean formation will be examined, as will those of subduction and mantle plumes. The students will examine evidence and constraints on interpretation of these processes operating in past geological eras: the Palaeozoic, Proterozoic and Archaean. Emphasis will be placed upon understanding examples from the tectonic evolution of the Indian Plate and features associated with Pakistan.

Contents

1. Internal structure of the Earth
2. Plate Tectonics
3. Sea floor spreading
4. Continental drift theory
5. Geological evidences of drifting theory
6. Various types of plate boundaries
7. Features related to plate boundaries
8. Processes of orogenesis
9. Different rock suits associated with plate margins
10. Triple junctions, Hot spots, Super Plumes
11. Different methods of relative plate motion calculation
12. Present day magmatism in relation to plate tectonics
13. A brief description of plate boundaries and related features in Pakistan

Recommended Texts

1. Kazmi, A. H., & Jan, M. Q. (1997). *Geology and tectonics of Pakistan*. New York: John Wiley & Sons.
2. Kearey, P., Klepeis, K. A., & Vine, F. J. (2009). *Global tectonics*. New York: John Wiley & Sons.

Suggested Readings

1. Keary, P. Vine, F., & Panza, G. F., (2000). *Global Tectonics.* Amsterdam: Wiley-Blackwell.
2. Belousov, V. V., & Maxwell, J. C. (2000). *Basic problems in geotectonics*. New York: McGraw-Hill.
3. Cox, A., & Hart, R. B. (2009). *Plate tectonics: how it works*. New York: John Wiley & Sons.

GEOL - 7118 Geotechnical Engineering 3(3+0)

The course focuses on strengthening students' knowledge in geotechnical engineering, exposing them to issues related to engineering geology, geotechnic foundation engineering, geological and rock engineering, hydrology, soil structure and pavement design/ analysis/ rehabilitation. Advance level courses have been designed in this group for specialization in geotechnical engineering (geological engineering) with an aim to meet the demands of country in the future. These courses will enable the students to fully understand (1) properties of rocks and soils and their role in construction industry, (2) risk assessment due to earthquake related seismicity and its intensity and (3) earthquake resistant infrastructure development. Students will be able to understand present the foundations of many advance Engineering tools and concepts related Geotechnical Engineering. This course will give an experience in the implementation of engineering concepts which are applied in field of Geotechnical Engineering. Especially the application of scientific and technical principles of planning, analysis, design of foundation along with soil improvement techniques at investigation / construction site locations.

Contents

1. Earthquake Engineering
2. Earthquake Risk Assessment
3. Earthquake Resistant Design
4. Rock and Soil Properties
5. Soil and Rock role in Construction Industry
6. Groundwater Systems
7. Excavation and Tunneling
8. Engineering Foundation
9. Dam Engineering
10. Pavement Design, Analysis and Rehabilitation
11. Rock Mechanics
12. Soil Mechanics
13. Engineering Geology II

Recommended Texts

1. Price, D. G. (2008). *Engineering geology: principles and practice*. London: Springer science & business media.
2. Blyth, F. G. H., & De Freitas, M. (2017). *A geology for engineers*. London: CRC Press.

Suggested Readings

1. Brady, B. H., & Brown, E. T. (2013). *Rock mechanics: for underground mining.* London: Springer science & business media.
2. Attewell, P. B., & Farmer, I. W. (2012). *Principles of engineering geology*. London: Springer science & business media.

GEOL - 7122 **Earthquake Seismology** **3(3+0)**

This is an advanced course designed for students involved in seismological or related research. The course objectives are to review a suite of advanced seismology topics related to earthquake processes and to seismic-wave propagation at a level that instills a deep appreciation of seismological methods in the students. The primary goal is help students learn how to study advanced material and to relate that material back to seismological observations using a mix of observation, computation, and theory. The aims of this course is provide students with advance knowledge of earthquake seismology, and seismotectonics. This course will equip the students with skills to improve understanding of the plate tectonic puzzle, and governing forces, and deformations along the main plate boundaries: earthquake source parameters and fault plane solutions and to improve the understanding, seismicity and distribution of stress regime within the lithosphere.

Contents

1. Earthquake Seismology
2. Tectonics and Earthquakes relationship
3. Elastic Waves theory, Mathematical analysis of seismological processes
4. Seismic waves and their analysis in earthquake seismology.
5. Frequency distribution of an earthquake and their Relationships
6. Magnitude distribution of an earthquake and their Relationship
7. Energy of an earthquake and their relationship
8. Earthquake Source parameters, Earthquake Source parameters determination
9. Fault plane solutions of earthquakes
10. Composite fault plane solutions of earthquakes and their determination
11. Earthquakes and their implication with plate boundaries.
12. Study of global pattern of seismology
13. Earthquakes and their relationship to the tectonics of the area

Recommended Texts

1. Bullen, K. E., & Bolt, B. A. (2000). *An introduction to the theory of Seismology*. Cambridge: Cambridge University Press.
2. Lee, W. H., Jennings, P., Kisslinger, C., & Kanamori, H. (Eds.). (2000). *International handbook of earthquake & engineering seismology*. Elsevier. Suggested Readings

Suggested Readings

1. Borr, M. H. P. (1982). *The interior of the earth: its structure, constitution and evolution.* London: Edward Arnold.
2. Shearer, P. M. (2019). *Introduction to seismology*. Cambridge: Cambridge university press.
3. Bullen, K. E., Bullen, K. E., & Bolt, B. A. (1985). *An introduction to the theory of seismology*. Cambridge: Cambridge university press.

GEOL - 7132 Applied Geochemistry 3(3+0)

Advance level course has been designed for specialization which enable the students to fully understand the basic concepts of thermodynamics, the geochemical techniques applied in mineral exploration, the isotopes and their role in source rock characterization and dating, the elemental distribution in sedimentary rocks, geochemical characteristics of igneous and metamorphic rocks and their petrogenesis. After completing these courses the students will be able to carry out their independent research related to the petrogenetic and paleotectonic history of various types of rocks and geochemical exploration of mineral deposits. Students will be able to describe the composition of the Earth´s main geochemical reservoirs and can explain element fractionation and how this can be used to understand endogenous and exogenous geochemical and geobiological processes. They will be able tell about stable isotopes and how such data can be used to understand various geochemical and geobiological processes. They can interpret how radiogenic isotope signatures can be used to trace the source of minerals, rocks and fluids describe the use of geochronology to date magmatic and metamorphic events. They could describe how chemical weathering of minerals and rocks control the composition of sediments/soil and natural water explain why carbon dioxide and the carbonate system play an important role in weathering reactions describe where the main global carbon reservoirs are, and the most important processes that control the global carbon cycle can use a precise scientific language to describe and discuss major geochemical processes has competence in scientific ethics and the ability to work independently and as part of a team.

Contents

1. Thermodynamics
2. Rare Earth Elements and Geochemistry
3. Resources, Reserves, Energy Resources, Mining, Environmental and Sustainability
4. Geochemical Exploration
5. Stable Isotope Geochemistry
6. Radio Isotope Geochemistry
7. Low Temperature Geochemistry
8. High Temperature Geochemistry

Recommended Texts

1. Rollinson, H. R. (2014). *Using geochemical data: evaluation, presentation, interpretation.* London: Routledge.
2. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2003). *Geochemistry: pathways and processes*. Columbia University Press.

Suggested Readings

1. Krauskopf, K. B., & Bird, D. K. (1982). *Introduction to geochemistry* (Vol. 72, No. 1). New York: McGraw-Hill.
2. Best, M. G. (2013). *Igneous and metamorphic petrology*. New York: John Wiley & Sons.

GEOL - 7136 Applied Geophysics 3(3+0)

This course is applied geophysics is designed to enable graduate students to get understanding for application of geophysical techniques to solving geoscientific problems in resource exploration and development, natural hazards, and pollution control. The course takes a practical, hands-on, field-oriented approach to show the applications of geophysics to these problems. For each topic, the course flow will proceed from basic principles (theory) through methodology and applications, to case histories. This course emphasizes applications, and keeps theory to essentials. The syllabus presents principles and operational procedures of each method initially, along with discussions of where the method is applicable, and is not applicable. Case histories will illustrate applications. The student will be able to demonstrate an advanced understanding of the physical principles underpinning geophysical methods. Critically evaluate geophysical techniques, acquisition procedures, and survey designs for various subsurface targets. Process and analyse collected geophysical data. Employ appropriate modeling methodologies, and evaluate strengths, weaknesses, and limitations. Infer physical properties at depth and formulate geological interpretations from those properties.

Contents

1. Study of geophysical features of the Earth
2. Study of gravity, magnetic, and temperature fields.
3. Geophysical methods.
4. Seismology
5. Heat Flow
6. Paleomagnetics
7. Study geophysical and geological processes in the context of plate tectonic theory.
8. Analysis of stress and strain.
9. Measurement and interpretation of strain in geological materials.
10. Elasticity applied to determine stress in the earth's lithosphere.
11. Creep of solids and flow of geological materials.

Recommended Texts

1. Everett, M. E. (2013). *Near-surface applied geophysics*. Cambridge: Cambridge University Press.
2. Selected Research Publications

Suggested Readings

1. Robinson, E.S. & Coruh, C. (2000). *Basic exploration geophysics*. New York: John Wiley & Sons.
2. Kearey, P., and Brooks, M. (2000). *An introduction to geophysical exploration.Singapore:* Osney Mead.
3. Robert J. Lillie, (2000). *Whole earth geophysics*: *an introductory textbook for geologists and geophysicists*, Prentice Hall.

GEOL - 7138 **Engineering Geology** **3(3+0)**

This course will introduce students to knowledge, theories, and debates about how the world's physical systems operate and the characteristics of different geological environments. The objective of this is to get students thinking about the big questions relating to the origins, make-up, and operations of the planet and how this relates to the engineering geologist's job of predicting how near-surface rocks, soils and groundwater will affect any man-made structure founded on, or excavated into, the earth. The buildings, bridges, tunnels, dams, towers, railways, roads, wharfs, aqueducts, canals, pipelines, airport runways, underground power stations, subsurface tanks – all these structures are built within or on the ground. The successful construction of the public and private infrastructure requires a proper understanding of the ground conditions that supports or encloses these structures. After the completion of this course the students will be able to understand how an engineering geologist can use this knowledge to assist in the safe design and construction structures and the successful prediction of ground conditions and likely behaviour of that ground, which has a very long history.

Contents

1. Rock and soil mechanics and its application in civil engineering
2. Study of geological factors in relation to the construction of buildings and foundations, roads, highways
3. Excavation and tunneling
4. Mine openings
5. Dams and bridges
6. Construction materials
7. Slope stability analysis
8. Hazard assessment
9. Mass movement, their causes and prevention
10. Application of geophysical methods for site investigation
11. Construction in earth-quake zone
12. Dams and their kinds geological investigations for selecting a site for a dam
13. Landslides
14. Classification, geometry, causes and preventive methods
15. Ground water and character of ground water
16. Case histories of important engineering projects (small and mega) in Pakistan

Recommended Texts

1. Attewell, P. B., & Farmer, I. W. (2012). *Principles of engineering geology*. London: Springer Science & Business Media.
2. Waltham, T. (2002). *Foundations of engineering geology*. New York: CRC Press.

Suggested Readings

1. Bell, F. G. (2016). *Fundamentals of engineering geology*. London: Elsevier.
2. Blyth, F. G. H., & De Freitas, M. (2017). *A geology for engineers*. New York: CRC Press.

GEOL - 7158 Tectonics of Pakistan 3(3+0)

This is MS level course related to tectonics of Pakistan. As Pakistan geographically lies between 60°E to78°E & 24°N to 37°N. It has high density of active faults and is seismically one of the most active area of the Asia. Tectonically it is located in the region of intersection of three plates, Indian, Eurasian and Arabian Sea. In the north, there is convergent plate boundary between Eurasian and Indian plate, resulting into great Himalaya. In the west the intersection between these two plates became transform in nature. In the south there is a Subduction zone known as Makran Subduction Zone (MSZ) due to the Subduction of Arabian sea plate under Eurasian plate.

Contents

1. Concept of Rodania, Pangea and Gondwana supercontinents
2. Permian separation of Afghan, Pamirs, Karakoram, Lahasa microcontinents, closure of Palaeotethys and accretion tectonics at Eurasia's southern margin
3. Early cretaceous split and northward flight of India, closure of northern Neotethys and collision tectonics of the Shyok Suture
4. Himalayan orogeny
5. Constraints on the timing of India-Eurasia collision
6. Tectonic zonation of Pakistan: each zone to be studied in terms of its geomorphology, tectonics, stratigraphy, metamorphism, magmatism and mineral deposits. Karakoram plate
7. Kohistan-Ladakh Island Arc Terrene
8. Swat, Besham, Hazara, Kaghan (Nanaga Parbat) blocks
9. The Hill ranges The boundary faults and related tectonics: MMT, MCT, PANJAL THRUST, MBT, MFT. Afghan-India collision zone: Indus, Kurram-Waziristan- Muslim Bagh-Bela Ophiolite/Melange belt. Sulaiman-Kirthar thrust-fold belt; Katawaz basin; Makran accretionary prism.
10. Arabian Sea tectonics, tectonics of passive margin of Indian plate

Recommended Texts

1. Kazmi, A. H., and Jan, M. Q. (1997). *Geology and tectonics of Pakistan*. Karachi: Graphic Publishers.
2. Khan, M. A., Trelaor, P. J., Searle, M. P., and Jan, M. Q. (2000). *Himalayan Tectonics*. Geological Society London, Special Publication.

Suggested Readings

1. Baig, M.S., Lawrence, R.D, and Snee, L.W. (1988). Evidence for late PRECAMBRIAN to early CAMBRIAN orogeny in northwest Himalaya, Pakistan., *Geological Magazine, 125* (1).
2. Baig, M.S., Snee, L.W., La Fortune, R.J., and Lawrence, R.D. (1989). Timing of pre Himalayan orogenic events in the northwest Himalaya: 40 Ar/ 39 Ar constraints. *Kashmir Journal of Geology, 6.*

MS
GEOGRAPHY

GEOG - 7101 Advanced Research Methods 3(3+0)

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Each research study has its own specific purpose, we may think of research objectives are: to create awareness among students regarding basics of geographical research. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies); To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as descriptive research studies); To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies); To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

Contents

1. Introduction
2. Research Problems and Plans
3. Types of Research
4. Formulating Research Objectives
5. Research Questions
6. Managing a Research: Selecting Research Methods
7. Data Analysis and Interpretation
8. Research Evaluation and Writing

Recommended Texts

1. Blaxter, L., Christina, H. & Malcolm, T. (2010). *How to research*. New Delhi: McGraw Hill.
2. Bordens, K. S. & Bruce B. A. (2011). *Research design and methods*. Singapore: McGraw Hill.

Suggested Readings

1. Clifford, N. (Ed.). (2012). *Key methods in geography*. Los Angeles: SAGE.
2. Cohen, L., Lawrence, M. & Keith, M. (2011). *Research methods in education*. London: Taylor & Francis Group.
3. Gay, L. R. (2012). *Educational research: competencies for analysis and application.* Paris: Macmillan Publishing Company.

GEOG – 7102 Techniques in Geo-informatics 3(3+0)

Many fields benefit from geoinformatics, including urban planning and land use management, in-car navigation systems, virtual globes, public health, local and national gazetteer management, environmental modeling and analysis, military, transport network planning and management, agriculture, meteorology and climate change, oceanography and coupled ocean and atmosphere modelling, business location planning, architecture and archeological reconstruction, telecommunications, criminology and crime simulation, aviation, biodiversity conservation and maritime transport. The importance of the spatial dimension in assessing, monitoring and modelling various issues and problems related to sustainable management of natural resources is recognized all over the world.

Contents

1. Introduction
2. Concept of Electromagnetic Radiation
3. Concept of GIS Data
4. Basic concepts
5. Data types
6. Creating Database, GIS data Inputs
7. Data Editing
8. Integration of RS and GIS datasets
9. Urban growth
10. Environmental management, Hazards
11. Land-use Planning
12. Wildlife
13. RS and GIS scenario in Pakistan context
14. Vast areas where RS and GIS is currently practicing

Recommended Texts

1. Aber, J. S., Marzol, f. I., & Ries, J. (2010). *Small-format aerial photography: principles, techniques and geoscience applications.* Amsterdam: Elsevier.
2. Campbell, J. B., & Wynne, R. H. (2011). *Introduction to remote sensing.* New York: Guilford Press.

Suggested Readings

1. Clarke, K. (2004). *Getting started with geographic information system.* New York: Prentice Hall.
2. Heywood, I., Cornelius, S. & Carver, S. (2011). *An introduction to geographical information system*. New Jersey: Prentice Hall.
3. Jensen, J. R. (2011). *Remote sensing of the environment: an earth resource perspective.* New Jersey: Prentice Hall.

GEOG - 7103 Advanced Quantitative Techniques 3(3+0)

To train students in collection, analysis, interpretation and presentation of quantitative spatial data and to enable them to organize and conduct independent research. To use database software for the analysis of both Spatial and Temporal data. Quantitative techniques are the techniques that are concerned with collection, organization, presentation, analysis and interpretation of data. The quantitative techniques in geography are a recent development. The hard numbers behind any good research project are called quantitative data. Quantitative data is the language of science. It uses mathematical models, theories, and hypotheses. Quantitative data and qualitative data, in which you observe the non-numerical qualities of your subject, go hand-in-hand.

Contents

1. Introduction
2. Measures of Numerical Distributions
3. Time Series
4. Samples and Sampling
5. The Relationship
6. The Trends
7. Multiple Regression and Correlation
8. Multivariate Analysis
9. Principal components analysis
10. Factor analysis
11. Discriminate analysis
12. Cluster observation
13. Cluster variables
14. Cluster K.means

Recommended Texts

1. Gregory, S. (2005). *Statistical methods and the geographer*. London: Longman.
2. Levin, J. (2006). *Elementary statistics in social research*. New Dehli: Pearson.

Suggested Readings

1. Mckillup, S. & Melinda D. D. (2010). *Geostatistics explained.* Cambridge: Cambridge University press.
2. Taylor, P. J. (2000). *Quantitative methods in geography*. Boston: Houghton Mifflin.
3. Walford, N. (2011). *Practical statistics for geographers and earth science.* Singapore: Wiley-Blackwell.

GEOG - 7106 Digital Cartography 3(3+0)

Cartography or mapmaking is the study and practice of making representations of the Earth on a flat surface. The discipline of cartography combines science, aesthetics, and technical ability to create a balanced and readable representation that is capable of communicating information effectively and quickly. Cartography is a complex, an ever-changing field, but at the center of it is the map-making process. Viewed in the broadest sense, this process includes everything from the gathering, evaluation and processing of source data, through the intellectual and graphical design of the map, to the drawing and reproduction of the final document. As such, it is a unique mixture of science, art and technology and calls for a variety of in-depth knowledge and skills on the part of the cartographer.

Contents

1. Classification of maps based on scale
2. Function and subject matter
3. Basic Mapping processes.
4. Shape & size of earth
5. Locational system
6. Shape refinements.
7. Geodetic control survey
8. Latitude, longitude determination.
9. Map Projections
10. Different types of map projections
11. Conformal, Equal area, Azimuthal, Polyconic, Universal Transverse Mercator
12. Cartographic Design
13. Colour/pattern creation and specification
14. Maps and graphs
15. Cartographic Tools
16. Advanced Mapping Environment
17. Computer Mapping
18. Multimedia Techniques in Cartography

Recommended Texts

1. Ahmad, Q, S. (2000). *Simple map projections*. Lahore: Publishers United.
2. Brewer, C.A. (2005). *Designing better maps: a guide for gis users*. Redlands: ESRI Press.
3. Brewer, C.A. (2008). *Designed maps: a sourcebook for GIS users*. Redlands: ESRI Press.

Suggested Readings

1. Dent, B. D. (1999). *Cartography: thematic map design*. Boston: WCB/McGraw-Hill.
2. Krygier, J. & Wood, D. (2005). *Making maps: a visual guide to map design for GIS.* New York: The Guilford Press.
3. Peterson, G. N. (2009). *GIS cartography: a guide to effective map design.* New York: CRC Press Taylor and Francis Group.

GEOG - 7107 Environmental Geography 3(3+0)

Environmental Geography, one of the most traditional parts of the discipline of Geography, encompasses natural science, social science, and humanistic understandings of the Earth's environment. Environmental Geographers study the complex relationships between humans and the natural environment over time and through space. This course will provide a historical, geographical, and humanistic foundation for understanding the environment and the plethora of environmental issues that confront us at the beginning of this century. It is a major aim of this course to produce environmentally aware students and to equip them with skills to enable them to become future decision-makers on environmental matters in whatever field they wish to pursue in the future. By studying this course students will be able to recognize what the issues are, and to view them from a geographic perspective. They will recognize the responsibilities they have in relation to other people, the environment, and sustainability, and there will be opportunities to initiate personal action.

Contents

1. Evolution of Environmental Studies in Geography
2. Comparative Advantage of Geography
3. Concept of environmental management
4. Environment and Man interaction, Ecosystem, natural resources
5. Important Cycles
6. Population explosion, The human impact on the environment
7. Environmental hazards, Types of Hazards
8. Major Environmental hazards and Problems in Pakistan: Floods, Earthquake, Tsunami, Cyclones, Landslides, Droughts, Deforestation and Desertification
9. Water-logging and Salinity
10. Soil Erosion
11. Global Warming and ozone depletion
12. Environmental Pollution , Waste Management, Control and Mitigation Measures, Technology, awareness, Legislation, Ethics
13. Pakistan Environmental Act
14. National Conservation Strategy
15. National Environmental Quality Standard

Recommended Texts

1. Arms, K. (2001). *Environmental science*. Philadelphia: Asunders College Publishing.
2. Basak, A. (2009). *Environmental studies.* New Delhi: Pearson.

Suggested Readings

1. Botkin, D. B. & Edward A. K. (2012). *Environmental science*. Hoboken: John Wiley & Sons.
2. Burton, I. R., W. Kates& Gilbert. F. W. (2000). *The environment as hazard.* Karachi. Oxford University Press.
3. Cunningham, W. P. (2007). *Environmental science: a global concern*. Boston: McGraw-Hill Higher Education.

GEOG - 7108 **Hydro Geography** **3(3+0)**

It describes advanced knowledge about Water resources, water resource management, Hydrology, distribution and availability of water. This course provides a basic introduction to hydrologic processes, including fundamentals of hydrology, rainfall-runoff modeling, hydraulic processes (including both pressurized pipe flow and open channel flow), and hydrologic frequency analysis. These fundamentals are then applied in the computation of design flows and in the analysis and design of hydraulic systems such as pipe networks and storm water management systems. Computational laboratory sessions (including geographic information systems and simulation models) and experimental laboratory sessions reinforce lectures and provide hands-on learning opportunities. By the end of this course, students should be able to apply standard techniques, computational tools, and data used by engineers in conducting hydrologic analysis.

Contents

1. Introduction
2. Hydrological Cycle and Water Balance: Water Reservoirs, Hydrological Cycle, Water Balance
3. Precipitation and Rainfall
4. Runoff: Factor affecting the Runoff, Runoff Cycle and Phases of Runoff, Measurement of Runoff
5. Ground Water
6. Floods: Causes and Seasonal Distribution of Floods, Flood Protection and Planning, Geographical Distribution of Floods
7. Glacial Water: Glacial Nourishment and Wattage, Glacial Runoff, Glacial Flow, Response of Glacier to Climatic Changes
8. Droughts: Extent and Distribution of Droughts, Drought Severity, Frequency and Duration, Hydrological Relations in Draughts
9. Lakes: Origin and Diversity, Hydrological Cycle and Water Balance Lakes, Geographical Distribution

Recommended Texts

1. Raghunath, H. M. (2006). *Hydrology: principles, analysis and design*. Amsterdam: New Age International.
2. Ward, R.C. & Robinson, M. (2000). *Principles of hydrology*. London: McGraw Hill.

Suggested Readings

1. Bittinger, M. W. (2000). *Water resources, use, and management.* Proceedings of a symposium held at Canberra. Edwin S. (Hill, Eds). Cambridge: Cambridge University Press.
2. Meinzer, O.E. (2000). *Hydrology.* New York: McGraw Hill.
3. Chow, V. T. (2000). *A handbook of applied hydrology.* New York: McGraw Hill.

GEOG - 7109 Cultural Geography 3(3+0)

This course provides an overview of the field of cultural geography. This area of study centers its Agricultural geography is a sub-discipline of human geography concerned with the spatial relationships found between agriculture and humans. Agricultural Geography provides the basic information of various types of the agriculture on the earth surface viz., Subsistence, commercial, horticulture, specialised etc. Agricultural Geography as a sub-discipline of human and economic geography. The geography of human activities is called as 'economic geography' which examines the primary, secondary, tertiary and quaternary activities of man. Man in his primeval stage was a hunter and gather and during the Neolithic period he learned the art of cultivation of crops. Thus, agriculture had been the dominant economic activity in the past and it is still the mainstay of over two-third of the world population. The study of agricultural geography is thus of great social relevance among all the branches of human geography.

Contents

1. Introduction
2. Basic themes of cultural Geography
3. Cultural History
4. Paleolithic Age: Hunting & Gathering Culture
5. Neolithic Age: Agricultural World Revolution
6. Revolution & Urbanization
7. Detailed Study of Stages of Social Cultural Change
8. Geo-Cultural Study of the following
9. Religion
10. Language

Recommended Texts

1. Fouberg, E. H., Murphy, A. B., & De Blij, H. J. (2009). *Human geography: people, place, and culture*. New York: John Wiley & Sons.
2. Terry G. J. Lester R. (2000). *Human mosaic.* New York: Harper Collins Publishers.

Suggested Readings

1. Atkinson, D., Jackson, P., Sibley, D., &Washbourne, N., (2005). *Cultural geography: A critical dictionary of key ideas.* IB Tauris.
2. Anderson, K., Domosh, M., Pile, S., & Thrift, N., (2002). *Handbook of cultural geography*. Singapore: Sage.
3. Horton, J., & Kraftl, P., (2013). *Cultural geographies: An introduction*. London: Routledge.

GEOG - 7110 Geography of Natural Hazards and Disasters 3(3+0)

This course covers the mitigation concepts, implementation approaches planning and types of Hazards. It is a multidisciplinary research oriented subject for planning and development. This is a course on applied hazard mitigation, but because it is a graduate level course, the focus will not be only on the fundamentals of hazard mitigation but on the fundamentals and their application. Students have had some introduction to hazard mitigation through NHDM. The application aspect of this course addresses the relationship of hazards and their behaviors which cause disasters and how local, state, and federal emergency management agencies can mitigate the potential threats. Hazard mitigation is actually hazards management, much like emergency preparedness, response, and recovery have to with disaster management. Thus, in emergency management we deal with both hazards and disaster management. The approach used in this present course is to address hazards management or the management of hazards so that future disaster impacts will be reduced or eliminated.

Contents

1. The Concept
2. The Nature of the Phenomena
3. Dynamics of Potentially Disastrous Natural Hazards
4. Impact of Natural Hazards and Likely Disasters
5. Scale
6. Risks
7. Vulnerability
8. The Disaster Management Cycle
9. Application of RS, GIS, GPS Tools in the Management of following Natural Hazards / Disasters
10. Flood
11. Earthquake
12. Cyclones
13. Rainfall
14. Efficacy of the Integrated Development Planning and Natural Hazards/ Disasters

Recommended Texts

1. Bryant, E. (2005). *Natural hazards*. Cambridge: Cambridge University Press.
2. Cochrane, M.A. (2009). *Tropical fire ecology: climate change, land use and ecosystem dynamics*. Springer: Praxis Publishing.

Suggested Readings

1. Ghosh, G.K. (2006). *Disaster Management*. New Delhi: A.P.H Publishing Corporation.
2. Pirarizy, A.A. (2002). *Environmental Geography and Natural Hazards*. New Delhi: A.P.H Publishing Corporation.
3. Smith, K. (2004). *Environmental Hazards. Assessing Risk and Reducing Disaster*. London: Routledge.

GEOG - 7111 Industrial Geography 3(3+0)

The term "industrial" includes those activities by which man changes the form or nature of raw materials, converting them into more useful products. The course focuses on explanations of factory location, the role of location in corporate strategies and the geographical structure of production systems, including industrial districts. Particular attention is paid to the organizational structure of the economy, especially the dominant role played by multinational firms (MNCs), and the forces that shape the agglomeration and dispersal of activity. These transforming operations are conducted in factories, to which are brought raw materials from various source regions and from which go finished products to diverse market regions. Factories which characterize industrial regions may be interrelated: some may supply semi-finished items to other factories; others may be branch plants; and still others may have a service relationship, such as a power plant, which supplies electrical energy to other factories. A relationship also exists between factories and non-factory elements

Contents

1. Introduction to Industrial Geography
2. Frameworks of Industrial Geography
3. The Industrial Revolution
4. The Evolution of manufacturing system
5. The differential space economy, World trade in manufacturing goods
6. Key concepts & Theories in Industrial Geography
7. Industry Dynamics
8. Industrial Trends In Asia
9. Trade competition
10. Technological capabilities & competitiveness
11. Clustering of Industrial activities
12. Future prospects
13. Study of Major Industries of the world
14. Wheat & Rice- The world's great foodstuff
15. The textile and clothing Industries

Recommended Texts

1. Alexanderson, G. (2000). *Geography of manufacturing*. Englewood Cliffs: Prentice Hall Publications.
2. Altaf, Z. (2000). *Entrepreneurship in the third world risk and uncertainty in industry in Pakistan.* London: Croom Helm, Ltd.

Suggested Readings

1. Chapman, K. & Walker, D.F. (1991). *Industrial Location*. (2nd ed.). Oxford: Wiley Eastern Ltd.
2. Emery, J.S. & Shaw, J.H. (2000). *Cities and Industries*. Milton: Jacaranda Press.

3. Hayter, R. (2000). *The Dynamics of Industrial Location*. New York: John Wiley & Sons

GEOG - 7112 **Medical Geography** **3(3+0)**

Medical geography is an important "new" area of health research that is a hybrid between geography and medicine dealing with the geographic aspects of health and healthcare. Medical geography studies the effects of locale and climate upon health. It aims to improve the understanding of the various factors which affect the health of populations and hence individuals. It is also called health geographics. Focuses on the design of GIS-based models to address health and healthcare issues. Topics include a conceptual framework, landscape epidemiology models, disease diffusion models, health accessibility, human health behavior and location-allocation of health services. Laboratory section provides hands-on experience applying these models with GIS tools.

Contents

1. Introduction to Medical Geography:
2. Definitions, themes, concepts, Nature & scope of Medical Geography
3. The Historical Development of Medical Geography
4. The status of Medical Geography.
5. Factors inflecting the Patterns of Health & Disease:
6. Geographical Factors.
7. Physical Factors / Environmental Factors.
8. Cultural Factors.
9. Socio – Economic & Political Factors.
10. Patterns & Processes of Health & Disease:
11. Spatial variations in health & welfare patterns.
12. Role of Geography in exploring the impacts of diseases.
13. Models in Medical Geography
14. Epidemiological Transition
15. Health & inequalities
16. Inverse care law.
17. Global Patterns of health & Disease.
18. Global Eradication of disease.
19. Progress in Medical Geography:
20. Recent Issues & Developments in Medical Geography.
21. GIS, Remote Sensing & Health studies.
22. Changing Societies & future Health care.
23. Geography, Health care & Planning.

Recommended Texts

1. Lloyd, J. (2002). *Health & welfare*. London: Holder & Stoughton.
2. Izhar, F. (2004). *Geography & Health: A study in medical Geography.* New Delhi: A.P.H. Publishing Corporation.

Suggested Readings

1. Leninan, J. & Fletcher, W.W. (2000). *Health & the environment* (1st ed.). Glasgow: Blacker & Sons Ltd.
2. Lloyd, J. (2002). *Health & welfare,* Holder & Stoughton London.

GEOG - 7113 Political Geography 3(3+0)

Political geography is concerned with the study of both the spatially uneven outcomes of political processes and the ways in which political processes are themselves affected by spatial structures. In this course, we will survey Political Geography, a subfield of Human Geography which focuses on questions of space and power and the interconnections of geography and politics. All politics are geographical, from the spatial arrangement of local governments to the territorial basis of international trade. We will explore how politics works with a concern for where political impacts occur at a variety of geographical scales (from the international to the local) while also considering how geographical factors impact political actions. We'll also examine the geography of various formal institutions and practices of politics as well as the informal politics of everyday life within places. In short, we'll explore how political power makes geographies and how, in turn, geography may be said to make politics.

Contents

1. Nature and objectives of Political Geography, Definition and development of political geographic thought.
2. A critical examination of the following:
3. Concept of environmental relationship in political geography.
4. The concept of geopolitics its development and short-comings
5. National deterministic theories of Germans and French possibilities.
6. State as a Politico-geographic Phenomenon:
7. Concept of the state and its classification. Chief political-geographic characteristics of states.
8. Hierarchy of political area.

Recommended Texts

1. Jones, M., Jones, R., Woods, M., Whitehead, M., Dixon, D., & Hannah, M. (2014). *An introduction to political geography: space, place and politics*. London: Routledge.
2. Kruys, B. G. G. (2002). Controlling land borders: A comparison of the United States of America, Germany and South Africa. *Strategic review for southern Africa*, *24*(2), 114.

Suggested Readings

1. Agnew, J. (1997). *Political geography: a reader.* London: Arnold.
2. Bakis, H. (1995). Communication and Political Geography in a Changing World' *Revue Internationale de Science Politique, 16* (3). 219–311.
3. Williams, N. (2009). *Border Politics: The limits of sovereign power: the limits of sovereign power*. Edinburgh: Edinburgh University Press.

GEOG - 7114 Population Geography 3(3+0)

This course introduces population geography to advanced undergraduate students, and graduate students. We will examine how and why aspects of population have been understood as 'problems' in different and times. he syllabus coverts the major concepts and basic tools of demography; key geographical and historical processes of population change such as fertility, mortality and migration; and the socio-economic, political, and environmental causes and consequences of population dynamics in different world regions and over time. The population dynamics are discussed in a way that incorporates economic, political, cultural and environmental issues. To develop this critical geographic approach to population issues, we will places examine trends in population, population patterns at several scales (global, national, urban) and the population processes (fertility, mortality, migration) that create them. Further, we will investigate how population processes are shaped by, and engender, larger processes of political, environmental, urban, economic, and cultural change.

Contents

1. Introduction
2. Population theories
3. Sources and methods of population data collection and associated problems
4. Population distribution and density
5. Urban and rural population
6. Population composition
7. Gender composition, age structure, marital status, families and households, languages, religions, ethnic groups etc.
8. Population dynamics
9. Patterns of fecundity and fertility
10. Morbidity and mortality
11. Migration and its types
12. Demographic transition
13. Population growth and change
14. Population Projections

Recommended Texts

1. Newbold, K. B. (2017). *Population geography: tools and issues*. Toronto: Rowman & Littlefield.
2. Ardagh, M. (2013).*Textbook of population geography.* New Delhi: Random Exports.

Suggested Readings

1. John. I. C. (1997). *Population geography*. Toronto: Rowman & Littlefield.
2. Majid, H. (1994). *Population geography.* Karachi: Anmol Publications
3. Polunin, N. (1998). *Population and global security.* Cambridge: Cambridge University Press.

GEOG - 7115 Regional Planning and Development 3(3+0)

Regional planning deals with the efficient placement of land- use activities, infrastructure and settlement growth across a larger area of land than an individual city or town. Regional planning is a sub-field of urban planning as it relates land use practices on a broader scale. It also includes formulating laws that will guide the efficient planning and management of such said regions. Regions require various land uses; protection of farmland, cities, industrial space, transportation hubs and infrastructure, military bases, and wilderness. Regional planning is the science of efficient placement of infrastructure and zoning for the sustainable growth of a region. A 'region' in planning terms can be administrative or at least partially functional, and is likely to include a network of settlements and character areas. In most European countries, regional and national plans are 'spatial' directing certain levels of development to specific cities and towns in order to support and manage the region depending on specific needs, for example supporting or resisting polycentrism.

Contents

1. Principles and Scope of Planning and Development
2. Planning: A Geographer's View, ii. Planning Processes
3. Planning as an Activity
4. Objectives in Planning
5. Objectives of Regional Development Efforts.
6. Implications of Regional Development:
7. Defining Regions,
8. Resources and Planning:
9. The Resource Base.
10. Resource Evaluation.
11. Utilization of Resources for Planning and Development.
12. Urban and Regional Planning:
13. Urban Growth Patterns.
14. Impact of Industrialization.
15. Planning for Cities and City Regions.
16. Rural Planning: Agricultural Planning and Rural Development.
17. The Human Factor in Agricultural Development.

Recommended Texts

1. Hall, P. (2000). *Urban and regional planning* (2nd ed.). London: Allen & Unwin.
2. Hudson, R. & Lewis J.R. (2000). *Regional planning in Europe*. London: Pion Ltd.

Suggested Readings

1. Birmingham, W., & Ford, A.G., (2000). *Planning and growth in rich and poor countries.* London: George Allen and Unwin Ltd.
2. Cox, K. R. (2000). *Location and public problems.* Oxford: Basil Black-Well.
3. Frey H. (1999). *Designing the city towards a more sustainable Urban Form*. London: Routledge.

GEOG - 7116 Urban Geography 3(3+0)

This course explores the setting in which more than half of the world's people live--the city. Cities are the largest human artifacts, but how do they emerge and evolve? What are the similarities and differences between cities? Why is the Central Business District of some cities thriving while others decline? These and many other questions are examined by urban geographers. This course will explore and analyze the various aspects, concepts and approaches of urban geography. The course will cover topics such as historic and contemporary urban development; spatial dimensions of the city; social and economic patterns; images of the city; inequality and the development of urban built environment. Throughout history, cities have been the centers of economic, political, and cultural life. Further, many of the critical issues of our time--social polarization, economic restructuring, environmental degradation, and poverty--are concentrated in urban areas. This course explores the relationships among cities in a global urban system as well as the internal spatial arrangement of cities. It asks questions about how people structure the spaces of cities as well as about how people's lives are affected by the ways cities are structured.

Contents

1. Origin of towns.
2. Site and situation concept.
3. Process of urbanization in the world.
4. Urban function, economic base of urban centers.
5. Formal and functional classification of towns
6. Towns as central place
7. Urban hinterland.
8. Urban structure-different theories
9. Hierarchy of settlements-city size distribution
10. Rank size Rule
11. Law of primate city.
12. Urban expansion, metropolitan decentralization
13. Rural urban fringe-urban social life.
14. Concept and principles of Planning.
15. History of Town Planning-ancient and medieval Modern Planning-urban development urban renewal neighbourhood planning.
16. A study of the process of urbanization in Pakistan.
17. Urban Slums

Recommended Texts

1. Pacione, M. (2013). *Urban geography: A global perspective*. Routledge.
2. Wheeler, J. O., & Holloway, S. R. (2004). *Urban geography*. John Wiley & Sons Inc.

Suggested Readings

1. Douglas, I., Goode, D., Houck, M., & Wang, R. (Eds.). (2010). *Handbook of urban ecology*. Routledge.

2. Mayer H.M. & Kohn C.F. (2000). *Readings in urban geography*. Chicago: University of Chicago Press.

GEOG - 7117 Digital Image Processing 3(3+0)

It describes knowledge about knowledge about Digital Image processing (DIP) and its practical implementation. To produce students, that has applicable knowledge about basic tools of image processing and sensor's system. The course aims to equip students with overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation, and morphological image processing. Since 1964 the advent of large-scale digital computers and the space program have made digital image processing one of the most rapidly growing fields in electrical engineering. Now image processing has found much more wide applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, law enforcement, defense, intelligence. With the progress made in multimedia these days, digital image processing finds more wide applications. It has become an indispensable part of our digital age.

Contents

1. Introduction
2. Image pre-processing
3. Contrast Manipulation
4. Level slicing
5. Contrast stretching: linear or Non Linear
6. Spatial Texture Manipulation
7. Spatial Filtering
8. Directional and Gradient Filters
9. Edge Enhancement
10. Fourier Analysis

Recommended Texts

1. Lilles T. M. & Kiefer, R. W. (2004).*Remote sensing and image interpretation.* New York: John Wiley & Sons.
2. Campbell, J. B. &Wynne, R. H. (2011).*Introduction to remote sensing*. New York: Guilford Press.

Suggested Readings

1. Lo, C. P. (2000). *Applied remote sensing.* Essex: Longman.
2. ITC (2004). *Principles of remote sensing.* ITC Educational Textbook Series. Enschede, The Netherlands.
3. Muralikrishna, I. V. (1992). *Remote sensing applications and geographic information systems.* New Delhi: McGraw Hill.

GEOG - 7118 Advanced Techniques in Geographical Information Systems 3(3+0)

The course aims to equip students with an understanding of GIS, evolution and applications of spatial data. In this class, students will be introduced to the study and design of maps, primarily through the application of a specialized computer mapping software program known as a Geographic Information System (GIS). GIS is a map-based computer decision support system that allows for the investigation of geographic data relationships. People that are trained in GIS are in high demand today, both in government and private industry. The lecture sessions in this class will focus primarily on GIS-based mapmaking techniques, including map design, symbology, map coordinates and georeferencing systems. Students will cover many important aspects of mapmaking, including map data collection and processing, field methods and GPS, cartographic communication, topographic map reading and analysis, and qualitative and quantitative mapping techniques.

Contents

1. Introduction to GIS
2. Spatial Data
3. GIS Data Structures
4. Spatial Data Modeling
5. Attribute Data Management
6. Spatial Data Input and Editing
7. Spatial Data Analysis
8. GIS Output
9. GIS Project Design and Management
10. Problem identification
11. Designing a data model
12. Project management
13. Implementation problems
14. Project evaluation

Recommended Texts

1. Chang, K. (2006). *Introduction to geographic information systems*. Boston: McGraw-Hill Higher Education .
2. Demers, M.N. (2002). *Fundamentals of geographic information systems*. New York: John Wiley & Sons.

Suggested Readings

1. Yeung., Lo, C.P. & Lal, A. K. (2003). *Concepts and techniques of geographic information system.* New Dehli: Prentice Hall.
2. Kiser, J.D., & Paine, D.P., (2003). *Aerial photography and image interpretation*, New York: John Wiley & Sons.
5. Janssen, L. L., &Huurneman, G. (2000). *Principles of remote sensing*: ITC, International Institute for Aerospace Survey and Earth Sciences.

GEOG – 7119 Principles of Remote Sensing 3(3+0)

It describes about knowledge of Remote Sensing (RS) and its practical implementation. To produce students, that has applicable knowledge about basic tools of GIS. The course aims to equip students with an understanding of GIS, evolution and applications of spatial data through Geo-spatial technologies. Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area. Special cameras collect remotely sensed images of the Earth, which help researchers "sense" things about the Earth. It introduces knowledge of recording earth's surface features from space-borne platforms and different ways in which images can be analyzed. It will enable students to develop an understanding of common remote sensing products such as, earth resources satellite images, aerial photographs etc to develop a comprehension regarding ground-truthing aided by GPS.

Contents

1. Concepts and Foundations
2. Characteristics of Remote Sensing Systems
3. Ground Data Collection
4. Multispectral, Thermal and Hyper-spectral Scanning
5. Satellite Systems
6. Digital Image Processing
7. Application of Remote Sensing
8. Land Cover Mapping
9. Land use change monitoring
10. Urban expansion Mapping
11. Environmental Monitoring
12. Cadastral Mapping

Recommended Texts

1. Lilles T. M. & Kiefer, R. W. (2004).*Remote sensing and image interpretation.* New York: John Wiley & Sons.
2. Campbell, J. B. &Wynne, R. H. (2011).*Introduction to remote sensing*. New York: Guilford Press.

Suggested Readings

1. Lo, C. P. (2000). *Applied remote sensing.* Essex: Longman.
2. ITC (2004). *Principles of remote sensing.* ITC Educational Textbook Series. Enschede, The Netherlands.
3. Muralikrishna, I. V. (1992). *Remote sensing applications and geographic information systems.* New Delhi: McGraw Hill.