SSJDVSSS Govt. P. G. College Ranikhet, Almora

DEPARTMENT OF GEOGRAPHY

Post Graduate (MA/MSc) Course Framework of Geography

Sl No	Semester	Course Type	Course Code	Course Title
1	MA I Semester	Core Course-Major	101	Advanced Physical Geography
		Core Course-Major	102	Natural Resource Management
		Core Course-Major	103	Advanced Geography of India
		Elective (optional)	104	Soil Geography
		Elective (optional)	105	Geography of Tourism
		Elective (optional)	106	Integrated Mountain Development
		Core Course-Minor	107	Dissertation (Minor)
		Core Course-Minor	108	Seminar/Presentation
		Practical	109	Topographical, Basic RS, GIS & GPS
		Practical	110	Field Study & Report
2	MA II Semester	Core Course Major	201	Advanced Geomorphology
		Core Course Major	202	Urban environment & Planning
		Core Course Major	203	Evolution & Development of Geographical Thought
		Elective (optional)	204	Remote Sensing Applications
		Elective (optional)	205	World Regional Geography
		Elective (optional)	206	Bases of Hydrology
		Core Course-Minor	207	Dissertation
		Core Course-Minor	208	Seminar/Presentation
		Practical	209	Quantitative Techniques & Cartographic Representation of Data
		Practical	210	Field Survey
3	MA III Semester	Core Course Major	301	Environmental Management & Sustainable Development
		Core Course Major	302	Agriculture Geography and Agro-ecosystem Management
		Core Course Major	303	Rural Development & Planning
		Elective (optional)	304	Climate Change, Impacts & Adaptation in Himalaya
		Elective (optional)	305	Social & Cultural Geography
		Elective (optional)	306	Glacial Geomorphology
		Core Course-Minor	307	Dissertation
		Core Course-Minor	308	Seminar/Presentation
		Practical	309	Surveying & Map Projection
		Practical	310	Field Survey
4	MA IV Semester	Core Course Major	401	Advanced Geography of Uttarakhand
		Core Course Major	402	Population Geography & Human Resource Development
		Core Course Major	403	Biogeography
		Elective (optional)	404	Integrated Watershed Management
		Elective (optional)	405	GIS & GPS Applications
		Elective (optional)	406	Disaster Management
		Core Course-Minor	407	Dissertation
		Core Course-Minor	408	Seminar/Presentation
		Practical	409	Surveying & Map Projection
		Practical	410	Field Survey

Program Outcomes (POs)

PO1	Have in-depth knowledge of lithosphere along with origin of earth and related theories, atmosphere and hydrosphere
PO2	Know about the resources, classification, resource inventory (mapping), carrying capacity of resources and the management of resources for sustainable development.
PO3	Understand the physical aspects of India along with population, agriculture, industry and resource base and the regional division of India.
PO4	Have knowledge about soil properties, morphology, soil formation, soil capability, taxonomy, processes of soil degradation and the management of soil.
PO5	Understand the importance of geography in the perspective tourism, spatio-temporal context, dimensions and measurements and more importantly the tourism industry and environment.
PO6	Understand the world mountain system, socio-cultural characteristics of mountain region, resources, global environment changes and mountain environment and the integrated development in Himalaya with respect to UN sustainable development goals.
PO7	Learn practically the basics skills of research, field survey, data collection, data analysis, interpretation of outcomes and report writing and also learn the skills to presenting the outcomes through presentation and seminar.
PO8	Practical knowledge of Topographical Maps, slope analysis and profiles, Drainage analysis, data representation and geological map interpretation.
PO9	Know concepts, theories and processes of landform evolution and application of geomorphological knowledge for the benefit of society.
PO10	Know concept, types, morphology and functions of urban areas along with the urban environmental problems and urban planning and management
PO11	Understand the basic concepts of geography, development of geography since the Greek and Roman classical periods to modern times, contemporary and recent trends in geography.
PO12	Have knowledge about remote sensing, Aerial Remote Sensing, Thermal and Microwave Remote Sensing, Digital Processing of Remote Sensing Data and application of Remote Sensing in various fields.
PO13	Understand the natural regions, resource and cultural regions and the economic regions of the world and thereby know the meaning and importance of regional planning and development.
PO14	Understand about hydrological cycle, underground water and movement and the surface flow measurement techniques.
PO15	Practical knowledge of statistical data analysis techniques and statistical testing of data, cartographic representation of geographical data and digital processing of remote sensing data.
PO16	Knowledge of Environment, environmental problems, sustainable development and the management of the environment.
PO17	Understand the types of agriculture, techniques of agricultural regionalization, have knowledge about agroecology and ecology thereby planning and management of agriculture.
PO18	Know about rural planning and development, dimensions of rural economy and the rural development programs and policies in India.
PO19	Have the idea about climate change and its trends, climate change induced natural disaster, vulnerability and risk and the climate change adaptation in Indian Himalaya.

PO20	Know about the glacial and periglacial processes, associated landforms and adaptation of human beings in periglacial environment.
PO21	Develops practical skills of surveying through prismatic compass, dumpy level and clinometer and also know about map projections.
PO22	Have in-depth knowledge about physiography, geology, climate, soil, drainage, population, agriculture, resources and industries of Uttarakhand and the future prospects of Uttarakhand.
PO23	Know in details the demography, population data, demographic traits, trends of human migrations, population projection and planning.
PO24	Come across the fundamental concepts of plant geography, zoogeography, biodiversity, climate change and impact on plant and animals and biotic resource management.
PO25	Learn about concepts of watershed, disaster management at watershed level, transboundary watershed management in Himalaya and the integrated watershed management.
PO26	Know about the emerging techniques of Geographical Information System (GIS), Geographical data sets, application of GIS, Global Positioning System (GPS) and application of GPS.
PO27	Have knowledge about the concepts of disaster management, preventions, mitigation and preparedness for disaster management, response to disaster and the regional patterns of disaster management.
PO28	Practical exposer of survey through theodolite, telescopic alidade, abney level and sextant also practically learn GIS techniques and measurement of spatial patterns of distribution.

Program Specific Outcomes (PSOs)

PSO1	Develop a better perspective of man and environment relationship in terms of physical and cultural variations over the earth surface.
PSO2	Have better understanding of ecology and environment and thereby appreciate the sustainable use of resources.
PSO3	Proficiency in collecting and analyzing real earth information (data) and thereby develop a skill of informed decision making.
PSO4	Integration of geographical knowledge with various fields of planning, management and regional policy and decision making.
PSO5	Develop capacity to find solutions of ever-increasing risk and geo-environmental and social problems that the present-day society is facing day to day.
PSO6	Able to apply the knowledge of Spatial Techniques, Geoinformatics (Remote Sensing, GIS and GPS) in the new areas.

Course outcomes (COs) MA Geography

MA I Semester	
Paper I: Advanced Physical Geography – 101 (GMP P-CCM-i)	
CO1	Know about the physical geography and its scopes and branches
CO2	Develop in-depth insight about origin of earth, earth's interior, earth's movement and related topography
CO3	Have knowledge about the origin of continents and ocean basins and related theories, including mountains building processes, Gradational processes, Weathering and Erosion.
CO4	Know about different types of rock, their origin and influence on land form and topography
CO5	Understand the processes of erosion, deposition and resulting landforms.
CO6	Learn about the structure of atmosphere, insolation, distribution of atmospheric temperature, pressure and pressure belts, Winds: Planetary, Periodic and Local.
CO7	Able to know ocean bottom topography, ocean deposits, salinity, temperature, ocean currents, tides and coral reefs
Paper II: Natural Resource Management, Code-102 (GM P-CCM –ii))	
CO1	Understand the ecological processes, including human impacts on ecosystemschange, natural succession and the future sustainability of natural resources.
CO2	Characterize natural resources and be able to quantify at least one of these resources.
CO3	Know desired future conditions to achieve natural resource-related objectives, management actions needed to achieve those objectives, and evaluate success of these actions.
CO4	Learn about the management and allocation of natural resources- laws, policies, economic factors and characteristics of private and public resource owners and users.
CO5	Communicate effectively, orally and in writing, with audiences of diverse backgrounds.
CO6	Develop an outlook to work effectively with, and within, interdisciplinary and diverse groups to resolve management problems and achieve management objectives.
Paper III- Advanced Geography of India, Code- 103 (GMP-CCM – iii)	
CO1	Able to understand the physical aspect of India including mechanism of monsoon, soils and natural vegetation
CO2	Have fair knowledge of distribution, growth, problems and policies of Indian Population along with ethnic and racial diversity in India
CO3	Knowledge about agriculture infrastructure, institutions, agricultural regions and agricultural revolutions and policies in India.
CO4	Deep knowledge of the industries in India – factors affecting location, types, policies, industrial complexes and regions and globalization and liberalization.
CO5	Fair knowledge of the regional units of India and their geographical characteristics
Paper IV (a)- Soil Geography, Code-104 (GMP-EC–i)	
CO1	Able to define soil and understand the importance of soil.
CO2	Be familiar with the processes of soil layer formation

CO3	Know why plants need soil and the strategies of soil resource management
CO4	Understand moisture retention capabilities of the three major soil particles
CO5	Able to have detailed knowledge about the functions of soil.
CO6	Understand the importance of soil layer, ways soil can be enriched and conserved.
Paper IV (b)-Geography of Tourism, Code-105 (GMP-EC - ii)	
CO1	Understand the scope, definition, significance and development of geography of tourism.
CO2	Able to evaluate the impacts of tourism on present and future economies, cultures, societies, and physical environments.
CO3	Know about the fundamental concepts of tourism, classification of Tourism and able to describe resources and infrastructure required for Tourism
CO4	Understand the concept and significance of Ecotourism, and new emerging trends in Tourism
CO5	Understand about the tourism marketing, tourist product, tourism circuits and Tour Agencies
CO6	Know about the globalization and tourism; tourism resource and growth of tourism in India, National Tourism Policy in India, Tourism Organizations in India and Tourism in Uttarakhand
Paper IV (c)-Integrated Mountain Development with special reference to the Indian Himalaya, Code: 106 (GMP –EC–iii)	
CO1	Understanding about the major mountains of the world including their geology, physiography, climate, demography and socio-cultural characteristics.
CO2	Able to appreciate mountain resources – land, water, forest, wildlife, biodiversity and their development.
CO3	Have knowledge about mountain environmental changes and its impacts and adaptation
CO4	Knowledge of natural disaster and their challenges and strategies in Mountains
CO5	Have idea about different mountain institutions and their role in environmental governance.
CO6	Learn the importance of the integrated and sustainable development in mountain areas.
Dissertation (Minor) Code: 107 (GMP - CCm –i)	
CO1	Learn primary and secondary data collection methods and gain research skills
CO2	Develop quantitative and qualitative research aptitudes
CO3	Learn to synthesise information and analytically process data
CO4	Learn to work in a systematic way through a research design
CO5	Know to interpret the finding and summarise key findings
CO6	Learn to prepare report in the form of Dissertation
Seminar/Presentation, Code: 108 (GMP - CCm–ii):	
CO1	Learn the skill of synthesizing and grasping the knowledge
CO2	Learn the art of summarising facts into logical order
CO3	Excel the art presentation in timeframe manner and clarify doubts raised
CO4	Able to formulate pertinent questions through peer activity
CO5	Master the skill of looking into the mater critically

Practical-: Topographical Analysis and Interpretation of Geologocal Maps and Field Survey, Code: 109& 110 (GMP - P-i & P-ii)	
CO1	Learn to read and extract maximum information from Indian topographical maps
CO2	Gain the skill to interpret topographical maps
CO3	Learn to prepare base map, index map, drainage map, settlement map from the toposheets
CO4	Understand the key concepts of Geological maps and learn the skills of preparing geological cross-section
CO5	Learn to interpret the geological maps
MA II Semester	
Paper I- Advanced Geomorphology, Code: 201 (GMP-CCM – i)	
CO1	Deep knowledge of geomorphology and the recent trends
CO2	Have knowledge about the tectonic, glacial, periglacial, arid, fluvial and karst processes of landform development.
CO3	Understand the evolution of landforms – cyclic and polycyclic landforms.
CO4	Knowledge about the hill-slope development, erosion surfaces and know geomorphic mapping techniques
CO5	Application of geomorphic knowledge for the betterment of society.
Paper II- Urban Environment and Planning, Code: 202 (GMP-CCM-ii)	
CO1	Understand the concepts, meaning and the significance of urban geography and planning.
CO2	Learn the evolution of urban centres and urbanization processes, urban sprawl and satellite towns.
CO3	Knowledge of urban morphology, urban landscape, urban landuse system and functional classification of towns
CO4	Know the meaning and essence of central place, centrality and hierarchy of urban centres.
CO5	Develop understanding about urban problems, carrying capacity of urban lands, urban environmental change.
CO6	Idea of risk of urban growth with particular reference to developing countries, India and Mountain regions.
CO7	Knowledge of landscape ecology and sustainable urban development
CO8	Better understanding of urban landuse planning application of remote sensing and GIS in urban planning and management.
Paper III -Evolution and Development of Geographical Thoughts, Code: 203 (GMP-CCM – iii)	
CO1	Able to understand the concepts and philosophy geography along with its main branches.
CO2	Learn the evolution of geographical knowledge by the contribution of Greek, Roman and Arab scholars.
CO3	Have knowledge about the contribution of age of discovery, contribution of founders of modern geography and contributions of German, French and Anglo-American thinkers.
CO4	Have better understanding about contemporary quantitative, qualitative and changing paradigms in geography.

CO5	Knowing dualism or dichotomies in geography and the recent trends in geography.
Paper IV (a)- Remote Sensing Applications, Code: 204 (GMP-EC – i)	
CO1	Students will develop the knowledge about concept of remote sensing, sensors and remote sensing data products.
CO2	Know about the aerial photos, techniques of aerial photo interpretation and the geometry of aerial photographs.
CO3	Learn the techniques of digital image processing and image classification procedures.
CO4	Develop the knowledge about types, characteristics and application of thermal and microwave remote Sensing
CO5	Learn the applications of remote sensing in terrain evaluation, land use and forest resource inventory.
Paper IV (b)-World Regional Geography, Code: 205 (GMP-EC – ii)	
CO1	Students will be able to apply geographic concepts to the study of regions or a specific region
CO2	Become able to compare and contrast human and physical patterns and their variations overspace.
CO3	Knowledge of physical regions, vegetation regions, climatic regions, Bio-geographical regions and biomes.
CO4	Develop an appreciation of the resource regions, population regions and cultural regions of the world.
CO5	Understand agricultural and industrial regions of the world and micro agro-industrial regions of USA, Japan and China
CO6	Know about the importance of regional planning and development and approaches and methods of regional planning.
Paper IV (c)-Bases of Hydrology, Code: 206 (GMP-EC-iii)	
CO1	Students will learn about different physical aspects of water as a natural resource.
CO2	They will learn some water conservation strategies and water resource management.
CO3	Understand the hydrological properties of rock and water types found in them
CO4	Know about the structure of underground hydrosphere and underground water classification
CO5	Knowledge of hydraulic conductivity, permeability, transmissibility and the importance of artificial recharge.
CO6	Learn the techniques of channel flow measurement, hydrograph analysis and have general knowledge about the surface water resource.
PRACTICAL-: Quantitative Techniques and Cartographic Representation ofGeographical Data (GMP-P-i) &(ii) Field Survey (GMP-P-ii)- Code: 209& 210 (GMP - P-i & P-ii)	
CO1	Develop the skills sampling techniques, probability and the test of significance in testing hypothesis
CO2	Practically enrich the proficiency of measure of dispersion including mean deviation and standard deviation.
CO3	Understand significance of statistical correlation and regression and their applications.
CO4	Knowledge of the development of cartography and learn the skills of representation geographic data through cartographic tech techniques

CO5	Know about the components and platforms of remote sensing, stereoscopic test, and learn the interpretation of remote sensing data
SEMEST ER –III	
Paper I- Environmental Management and Sustainable Development - Code: 301 (GM P-CCM –i))	
CO1	Better understanding about environment, environmental perception, environment and society and environmental geography
CO2	Know about environmental problems and their causes consequences at global, regional and local levels.
CO3	Understand the approaches to environmental management, disaster management and integrated watershed management.
CO4	Knowledge of sustainable development, its needs and sustainable mountain agriculture and livelihood.
CO5	Have idea about environmental changes in Uttarakhand, climate change adaptation and disaster management
Paper II- Agricultural Geography and Agroecosystem Management - Code: 302 (GM P-CCM –ii)	
CO1	Student will be able to understand the definitio, scope, significance and development of Agriculture Geography, as well as the approaches to the study of Agricultural Geography.
CO2	Knowledge of various types of agricultural practices around the world and major commodities in each type.
CO3	Know how to measure agricultural intensity, agricultural efficiency and also know methods of delimitation pf agricultural regions.
CO4	Have knowledge about the concept of agro-ecosystem and its types and functioning and most importantly about agro-ecosystem degradation and management.
CO5	Have better perspective of the problems agriculture in India and Uttarakhand and their management and planning.
Paper III- Rural Development Planning, Code: 303 (GMP-CCM – iii)	
CO1	Understanding of the meaning, scope, basic elements of the rural development and planning.
CO2	Knowledge about the size, structure and characteristics of rural economy along with concept and measures of rural poverty and rural industrialization.
CO3	Learn about different theories related to rural development and the changing paradigm of rural development.
CO4	Able to know in details about various rural development programs in India like Community Development Program, Panchayati Raj, Integrated Rural Development Programs, MAGNREGA, Special group and special area programs.
CO5	Know different levels and their function of rural development rural planning and also become acquainted with rural development policies in India.
Paper IV (a)- Climate change, Impacts and Adaptation in Himalaya, Code: 104 (GMP-EC–i)	

CO1	Students will develop understanding about the concept of climate change and global trends of climate change and its assessment in mountains.
CO2	Able to understand trends of climate change in Himalaya and corresponding effects in rainfall, temperature and western events.
CO3	Also, able to establish linkages between climate change and natural disaster and their impact on society and economy.
CO4	Know about the assessment of climate change vulnerability and risk and upstream and downstream linkages of climate change.
CO5	Understand the concept of climate change adaptation and role of local institutions in climate change adaptation.
CO6	Learn why and how it is necessary to mainstreaming climate change adaptation and disaster risk reduction.
Paper IV (b)- Social and Cultural Geography, Code: 305 (GMP-EC - ii)	
CO1	Students will develop understanding of the Social and Cultural Geography, Society, social plurality, cultural types, cultural divergence and cultural convergence.
CO2	Have better understanding of theories of evolution of races, physical characteristics and early patterns of races, and the migration and distribution of races.
CO3	Learn the evolution of later social and cultural groups and the socio-cultural diversity of the world as well as India.
CO4	Knowledge about the components of social diversity and the cultural regions in India and the elements of cultural regions.
CO5	Have fair amount of knowledge about the tribal groups and their distribution in India.
CO6	Learn the impacts of globalization and social transformation in India.
Paper IV (c)- Glacial Geomorphology, Code: 106 (GMP –EC–iii)	
CO1	Students will be able understand causes of ice ages and the Pleistocene glaciation its onset and retreat.
CO2	Learn erosional processes, glacial erosion and development of super-glacial, englacial and basal landforms
CO3	Knowledge about the depositional processes of glacier, stratified and non-stratified processes, forms of moraines, glaciofluvial and lacustrine environment.
CO4	Develop insight about periglacial processes and the mechanism of frost action.
CO5	Knowledge of periglacial landforms, frost action and landforms, mass wasting and landforms and adaptation of human being to periglacial environment.
Practical-: Surveying and Map Projection (Pi); & Field Survey (Pii), Code: 309& 210 (GMP - P-i & P-ii)	
CO1	Students have fair knowledge about nature, principles and types of surveying and practical learn surveying through prismatic compass.
CO2	Understand the Electronic Distance Measurement (EDM) and develop the proficiency of levelling with dumpy level.
CO3	Develop the skills of contouring and determining heights with the help of Indian Pattern Clinometer.
CO4	Understand about the map projection, types of projections and their merits, demerits and utilities.

CO5	Develop proficiency of making different types of map projection through mathematical methods.
SEMESTER – IV	
Paper I- Advanced Geography of Uttarakhand, Code 401 (GMP-CCM – i)	
CO1	Understand the location, geostrategic and geo-environmental background of Uttarakhand and the geology, physiography, climate, drainage, flora and fauna and biogeographic regions of Uttarakhand.
CO2	Able to understand spatial patterns, structure, composition and dynamics of Uttarakhand population.
CO3	Know about the tribal groups of Uttarakhand with reference to their spatial distribution, fair and festivals, language and dialects, settlements etc.
CO4	Understand about the agricultural characteristics and trends in Uttarakhand and impact of green revolution on agriculture of Uttarakhand.
CO5	Have clear vision of prospects of horticulture and floriculture development including medicinal and aromatic plants in Uttarakhand.
CO6	Knowledge about the major mineral deposits their distribution and production in Uttarakhand.
CO7	Clear understanding about energy resource in Uttarakhand along with development of hydro-electricity.
CO8	Insight of the spatial distribution of industries, principal industrial regions and trade and transport in Uttarakhand.
CO9	Develop perspective on the future development, sustainable development plans and environment hazards and management in Uttarakhand Himalaya.
Paper II- Population Geography and Human Resource Development, Code 402 (GMP-CCM-ii)	
CO1	Understand the Nature and Scope of Population Geography and their evolution, significance and approaches for the study
CO2	Understand the Sources of Population Data and History of World Population and some factors responsible for world population and data sources for study.
CO3	To understand the fundamental Concepts Related to Population such as density, over, optimum & under population, fertility, mortality and population for future perspectives.
CO4	To review and understand the subject matter with the help of Theories of Population
CO5	Knowledge of fundamental Statistical Analysis using Statistical Software MS-Excel
CO6	Understand the Population Movement, Migration and some causes, consequences and its effects.
CO7	Understand the Nature and Scope of Settlement Geography Characteristics of Rural and
CO8	Urban Settlements according to Indian Census and nature, scope, evolution andstudy methods.
CO9	Understand the history of population, distribution, density of population and knowledge about population theories
Paper III- Biogeography, Code:403 (GMP-CCM – iii)	
CO1	Students will understand the concept, scope, significance and development of Biogeography.

CO2	Learn about the elements of plant geography and distribution of forest along with major plant communities.
CO3	Able to understand relationship between zoogeography and environment, biomes and their types and biodiversity and its depletion through natural and man-induced causes.
CO4	Learn about paleo botanical and paleo climatological records of environmental changes and the impact of climate change on flora and fauna.
CO5	Knowledge about biotic resource and their conservation and the protected areas and their management.
Paper IV (a)- Integrated watershed management, Code: 404 (GMP-EC–i)	
CO1	Understand the fundamentals concepts related to watershed, significances of watershed development and demarcation of watershed.
CO2	Learn the significance of watershed approaches in mountain development.
CO3	Learn to mainstream climate change adaptation and disaster risk reduction in integrated watershed management.
CO4	Develop understanding about upstream and downstream linkages and know the significance of transboundary watershed governance.
CO5	Know about concept of integrated watershed management, natural resource management at watershed level and participatory watershed management.
Paper IV (b)- GIS and GPS Applications, Code: 405 (GMP-EC - ii)	
CO1	Understand basic concepts, components, and elements of GIS including georeferencing, data automation and attribute information
CO2	Learn about Geographic data types, spatial and non-spatial data, data capturing and database and spatial database management in GIS
CO3	Learn the principal functions of GIS including spatial modelling
CO4	Knowledge about the concepts, components and applications of GPS along with GPS accuracy
CO5	Learn the application of GPS in resource mapping and micro level surveying and tracking.
CO6	Know the application of GIS in natural resource management, urban management, environmental management and agricultural planning.
Paper IV (c)- Disaster Management, Code: 406 (GMP –EC–iii)	
CO1	Able to learn fundamentals of disaster management and the national disaster management policy.
CO2	Learn about prevention, mitigation, preparedness for disaster management and know about disaster and development, disaster legislature, etc
CO3	Knowledge about the disaster response system, rescue and evacuation and the incident command system
CO4	Learn about disaster recovery, post disaster review and damage assessment, relief, rehabilitation and reconstruction.
CO5	Understand about the importance of regional pattern of disaster management with reference to Uttarakhand.
Surveying, Interpretation of Geological Maps and Spatial Analysis (GMP-P-	

i) &(ii) Field Survey (GMP-P-ii)	
CO1	Understand the different surviving techniques.
CO2	Practically develop the proficiency of horizontal and vertical angle measurement with the help of theodolite.
CO3	Learn the use of telescopic alidade, Abney Level and sextant in determining heights and distance.
CO4	Acquire the knowledge of components of GIS and GPS, Elements of GIS and practically learn preparing base map using GIS and GPS.
CO5	Learn the methods of representing geographical data through various spatial techniques.
CO6	Learn about nearest neighbour analysis, rank score, Z-score, shape analysis, gravity model and network analysis

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