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Total Number of Pages : 01

M.Sc.I
FMCC501

5th Semester Regular Examination 2018-19

ADVANCED CALCULUS

BRANCH : M.Sc.I(MC)

Time : 3 Hours

Max Marks : 70

Q.CODE : E585

Answer Question No.1 which is compulsory and any FIVE from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions : (2 x 10)

- Define a functional with an example.
- State Euler equations for a functional of the form $V[y(x), z(x)]$ with fixed boundaries.
- Define central field with an example.
- Define extremal of a functional and variational problem.
- Define conjugate point in a central field.
- Define a nonlinear Volterra integral equation of second kind with an example.
- State Rodrigue's formula.
- Write Legendre Polynomials $P_0(x), P_1(x), P_2(x)$ and $P_3(x)$.
- Show that $\phi(x) = 1-x$ is a solution of the integral equation.

$$\int_0^1 e^{x-\xi} \phi(\xi) d\xi = e^x(2 - e^{-1})$$

- Define a convolution Kernel with an example.

Q2 State and prove the fundamental lemma of the calculus of variations. (10)

Q3 Find the extremals of the functional (10)

$$V[y(x), z(x)] = \int_0^{\frac{\pi}{2}} [(y')^2 + (z')^2 + 2yz] dx, \quad y(0) = 0, y\left(\frac{\pi}{2}\right) = 1, \\ z(0) = 0, z\left(\frac{\pi}{2}\right) = -1$$

Q4 a) Show that a boundary value problem of a second order differential equation can be reduced to a Fredholm integral equation of the second kind. (7)

b) Differentiate between Fredholm Integral Equation and Volterra Equation. (3)

Q5 Test for an extremum of the functional (10)

$$\int_0^{x_1} \frac{1}{y} \left[\sqrt{1 + (y')^2} \right] dx,$$

given that $y(0) = 0$ and $y_1 = x_1 - 5$

Q6 State and prove the orthogonality property of the Legendre polynomials. (10)

Q7 a) Define resolvent kernel. (2)

b) With the aid of the resolvent kernel, determine the solution of the integral equation (8)

$$\phi(x) = \cos x + 2 \int_0^x e^{x-\xi} \phi(\xi) d\xi,$$

Q8 Show that the positive zeros of $J_0(x)$ and $J_1(x)$ separate each other. (10)



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